

NATURAL HISTORY

SOUTH AMERICA

THE ANDES: A NEW WORLD BY FRANK M. CHAPMAN—
COLLECTING MAMMALS IN THE HIGH ANDES OF
ECUADOR BY H. E. ANTHONY—FREDERIC E. CHURCH,
PAINTER OF THE ANDES BY H. F. SCHWARZ—ALEX-
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PLORER—HUNTING NEW FRUITS IN ECUADOR BY
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PANAMA

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The American Museum is under especial obligations for the generous aid accorded its expeditions by representatives of the South American governments and of Panama and for the hospitality and friendly spirit manifested by individuals in the regions where the explorations were conducted.

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MUSEUM OF NATURAL HISTORY
EXPLORATION · RESEARCH · EDUCATION

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The Oceanic Issue

In the previous numbers of NATURAL HISTORY published this year great continental areas—Australia, Asia, Africa, South America—have successively received emphasis. In the September-October issue the reader will be invited to step off *terra firma* and to cruise with the Whitney South Sea Expedition in the island-dotted Pacific. Dr. Robert Cushman Murphy, associate curator of marine birds in the American Museum, will tell of the significance of the work of this expedition, which has been engaged for four years in studying the bird life of Polynesia.

Marine mammals like the whales and seals that, departing from the ways of their landlubber relatives, have made the ocean and its shores their home, find a proper place in an **Oceanic Issue**, and special articles will be devoted to them, while it is hoped that some attention can be given also to those empire builders of the sea—the corals—which Dr. Roy W. Miner has recently been collecting at Andros Island in the Bahamas for the projected hall of ocean life in the American Museum. Features of this hall will be features also of this issue.

Finally, the great oceans themselves, occupying as they do more of the earth's surface than the combined land masses, will be treated from certain novel standpoints by Prof. W. M. Davis, the eminent geographer.



Photograph by F. M. Chapman

NORTHWEST SLOPE OF PICHINCHA, ECUADOR

The photograph, taken from an altitude of 11,000 feet, shows in the foreground a forest of the Humid Temperate Zone, the bird life of which is of tropical origin. The treeless slopes immediately above timber line are in the Páramo Zone, and their bird life is chiefly of Patagonian origin

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The Andes: A New World

By FRANK M. CHAPMAN

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IF the press despatches should report a heavy snowfall on the Amazon, we should question their accuracy. Nevertheless, snow does fall so frequently in Amazonian latitudes that great areas there are covered with it throughout the year. This apparent anomaly is to be explained, however, not in degrees of latitude but in feet of altitude. The whole problem can be encompassed in a glance when from the sweltering heat of Guayaquil we look upward to the eternal snows of Chimborazo; or, to take another example, when from the tropical coastal forests of Vera Cruz we see the white crown of Citlaltepētli, the "star mountain" of the Aztecs. These, indeed, are notable views. In both instances, faunally and climatically we are, as it were, standing on the equator and gazing at the poles!

Let us make this journey from endless summer to perpetual winter. If we measure our progress by the changes in climate which we shall encounter, we shall be traveling at a space-defying speed. It was von Humboldt who first determined the relations between latitudinal and altitudinal climates and, in his *De Distributione Geographica Plantarum* (Paris, 1817), he gives a diagrammatic representation of the plant zones on Chimborazo which might have been made by an ornithologist, so closely does the distribution of birds conform to that of plants,—evidence that both are subject to and obey the same laws.

In a general way it may be said that, as we proceed from the equator toward the poles, the mean temperature decreases one degree Fahrenheit with each degree of latitude. But as we ascend a mountain, the mean temperature decreases one degree with each three hundred feet of altitude. That is, approximately 300,000 feet of latitude equal 300 feet of altitude. If, therefore, our trip from Guayaquil is made up Chimborazo, we shall be traveling, climatically, somewhat more than one thousand times faster than we should have journeyed had we started for Panama!

Now, if we bear in mind the fact that the flora and fauna of a region are to a large extent an expression of its temperature, we shall have some conception of the rapidity with which the nature of the plant and animal life changes as we proceed from sea level to snow line.

It is not my present purpose to discuss here the factors which determine the limits of the faunal zones, or bands, which we shall find in ascending a snow-capped, equatorial mountain. The very fact that the mountain is snow-capped is graphic, convincing evidence of the relation between altitude and temperature. But just as rainfall, slope-exposure, topography, proximity to and temperature of the sea will determine the amount of snow, and the distances to which it descends on different sides of a mountain, so these and



A panoramic view of the Inca Mine at Santo Domingo in southeastern Peru

other factors govern the altitudes which mark the boundaries between faunal zones. The point I wish to make here is that these zones exist as well-defined bands of life the limits of which are subject to the control of natural laws. To discover those laws is the aim of the faunal naturalist or zoögeographer. In no other place will he find them more vividly expressed than on mountain slopes, where, as we have seen, the phenomena ordinarily spread over many miles of latitude are compressed within a few thousand feet of altitude.

My own investigations in this field have been made almost exclusively with reference to the distribution of birds; and it is a tribute to the potency

of the governing influences that they evidently control the distribution of these active creatures just as rigidly as they do that of quadrupeds or even plants and trees. Indeed, the potential mobility of birds combined with their unusually sensitive, responsive natures makes these animals particularly valuable indices of the effects of those forces and circumstances which are or have been active in producing faunal areas.

With this preamble, and avoiding details not essential to a general understanding of the more important facts concerning mountain life zones, let us as ornithologists make the proposed ascent of an equatorial mountain. We shall first pass through the Tropical Zone. The lowlands at the base of our



Photograph by Harry Watkins

This is a famous collecting locality in the Subtropical Zone

mountain may vary greatly in character. There may be arid plains, marshes, and luxuriant forests, all at the same level and within a short distance of one another. These, however, mark different types of habitats in the same life zone and we are not here concerned with the causes responsible for them. As we reach the foothills, we shall find further variations in habitat, which we may also disregard, other than to observe that due consideration must be given to habitat requirements in our broader study of distribution. Birds that are associated with sandy plains are not to be sought in marshes; nor shall we come upon forest-haunting species where there are no trees. The significant fact to re-

member is that when the habitat is favorable, we shall find that most of the birds of this Tropical Zone have so wide a latitudinal range that we might travel for weeks and still see them daily, whereas their altitudinal range is so limited that within a few hours we may leave them wholly behind, that is, below us.

When we have reached an altitude, usually of 4000 or 5000 feet (though under exceptional conditions it may be much less), we shall begin to observe birds we have not seen before and at the same time note the absence of others which were previously abundant.

We shall miss, for example, the great macaws, the harsh voices of which resounded through the forests lower



Photograph by Harry Watkins

Camp of the American Museum Expedition at Maraynioc, in the Humid Temperate Zone forests of eastern Peru.—More than a score of new species of birds have been discovered at this locality, and of these a number have not as yet been found elsewhere

down. Some of these birds are found in wooded regions from Bolivia to Mexico: that is, they have what may be termed a horizontal range of nearly 2500 miles. But their vertical range, as we have just discovered, is less than a mile.

We are now reaching an altitude where decrease in temperature produces condensation with resultant rainfall and an incredibly luxuriant vegetation. Every available foot of ground is claimed by trees and undergrowth, and every available inch of the trees is claimed by parasitic or epiphytic vegetation. This is the Subtropical Zone. It is a marvelous stratum of life occupying the mountain slopes, usually between the altitudes of 4000–5000 to 8000–9000 feet, and extending from Bolivia to Mexico.

The Subtropical Zone is remarkable not only for the richness of its life, but also for the high percentage of species found only within its boundaries. Thus, the American Museum's expeditions collected about 360 species of birds in the Subtropical Zone of the Colombian Andes, of which approximately three-fifths are practically confined to this narrow stratum of mountain life. This is about one-third as many as were encountered in the forests of the Tropical Zone. Comparison of the areas occupied respectively by the far-reaching tropical lowlands and the narrow subtropical belt further emphasizes the wealth and distinctness of the bird life of the Subtropical Zone.

At an elevation of from 8000 to 9000 feet we shall pass from the Subtropical into the Temperate Zone. The former is uniformly humid and forested; the latter has humid and arid divisions, the first of which is



Photograph by F. M. Chapman

Scene in the Subtropical forest on the summit of the western range of the Andes of Colombia.—Note the moss-covered tree trunks indicating the extreme humidity of the locality



Photograph by F. M. Chapman

Guallamba Cañon is a few miles north of the equator. This picture was taken from the Arid Temperate Zone looking down into the Subtropical Zone, where sugar cane is growing

wooded, the second treeless. Both divisions may occur at the same altitude, the difference between them being chiefly due to rainfall. Some of the most distinct species of Andean birds are found in the dense, scrubby forests of the Humid Temperate Zone. On the other hand, the species inhabiting the plains of the Arid Temperate Zone have changed but little from the types represented by their ancestors,—a phenomenon which forms an illuminating contribution to the study of evolution by environment. The upper limit of the Temperate Zone corresponds closely to the elevation at which agriculture ceases, that is, about 12,000 feet. Between this altitude and the lower level of permanent snow, which averages about 15,000 feet, lies the Páramo, or Puna Zone. In a measure

it is the equivalent of the tundra, that vast area which extends from the northern limit of forests to the shores of the Arctic Ocean. While few in numbers, nearly every bird of the Páramo is confined to this zone.

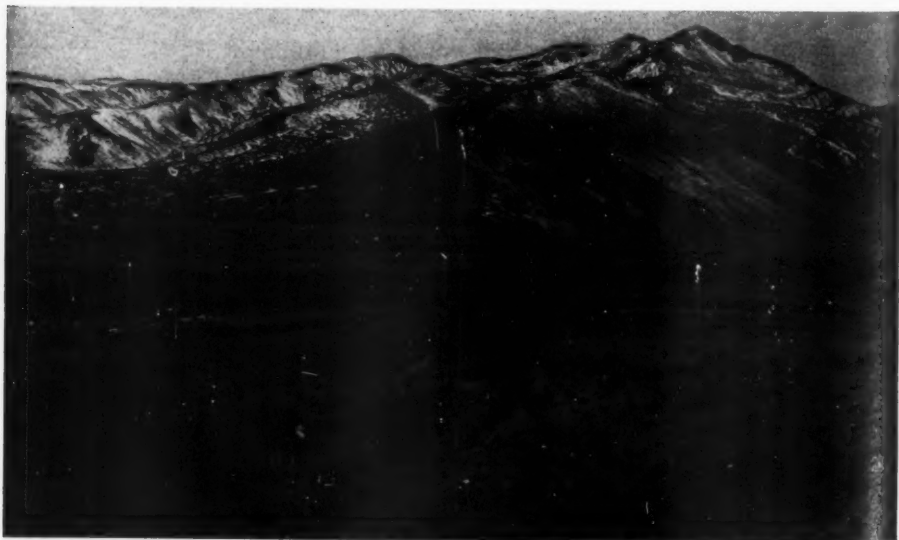
Without going further it is clear that in our vertical journey of less than three miles we have run the gamut of climatic and faunal zones: Tropical, Subtropical, Temperate, and Arctic or Antarctic—for the Páramo contains both boreal as well as austral elements.

The first and most significant fact for us to consider in connection with Andean life, and the one which makes its study of such surprising interest, is the comparatively recent origin of that life. It cannot, of course, be older than the region it occupies, and geologists tell us that the Andes did not



Photograph by F. M. Chapman

Mt. Aconcagua, Argentina, with an altitude of 23,000 feet, is the highest peak in the Western Hemisphere. The photograph was taken from an elevation of 11,000 feet in the Páramo Zone, at its base



Photograph by F. M. Chapman

This locality in the Páramo Zone at an altitude of 14,000 feet is immediately north of La Raya Pass, which separates Titicacan and Amazonian drainage in southern Peru. The Urubamba River, second longest tributary of the Amazon, rises in the small openings shown in the middle distance.

Photographed from the platform of a car on the railroad to Cuzco

attain their full elevation until the latter part of the Tertiary, at which time the continent of South America had essentially its present outline.

There is, consequently, good reason for calling the Andes a New World, or possibly we might better term them a recent annex to the world. Not only have we comparatively definite knowledge of the age of the Andes and of the character of the area from which they arose, but it is probable that at the time they had attained a sufficient elevation to support zonal life, the bird life of South America, in its major aspects at least, did not differ materially from that which exists there today. Hence it follows that not only can we give the Andes a geological birthday but we can form a fairly exact conception of the character of the avifauna from which the hundreds of species of birds that have evolved in them were derived.

Furthermore, we must remember that the value of the Andes to the biologist is increased by the regional compression or concentration of the forces which control distribution and promote evolution, and by the consequent definiteness with which these forces manifest themselves.

We must also take into consideration the topography of mountains as, through altitude, enclosed valleys, or disconnected summits, they supply the isolation which permits environmental or mutational factors, acting continuously on a comparatively limited number of individuals, to produce new forms. For instance, a distinct mutational form of tanager-finch (*Buarremon inornatus*), confined to the Chimbo Valley of Ecuador, and a hummingbird (*Oreotrochilus*) on Mt. Chimborazo are cases in point. Many others might be cited.

It is obvious, then, that in a study of the origin and distribution of life we can associate cause and effect far more often in the Andes than in those great continental areas, the early pages of the geological and zoölogical history of which are lost in an incalculably remote past. We ask, therefore, what are the factors which determine with such surprising definiteness the boundaries of these Andean life zones? Whence came the hundreds of species which are confined to them?

For some years the American Museum has been conducting explorations in the field and researches in the study designed to answer these questions. It was found that previously existing data were too inaccurate to be of value in determining exactly the ranges of the species to which they referred. It was necessary, therefore, to begin nearly at the beginning and work intensively at station after station from base to summit of the three ranges of the Andes in Colombia, where our survey was inaugurated. The outline of the life zones presented above is based chiefly upon our labors in that country. I shall not here go further into this phase of the subject but refer the interested reader to Volume XXXVI of the Museum *Bulletin*, where the results of the work in Colombia are presented in detail.

Satisfactory treatment of the origin of the birds of the Andes is too wide a problem to be handled locally. We have discovered, for example, the apparent ancestor of a subtropical Colombian motmot in the Tropical Zone of eastern Mexico. Again, a finch of the Páramo Zone has evidently come from Patagonia. It is obvious, therefore, that we have to deal not only with the *height* of the Andes but with their *length*. While at present this is

coextensive with that of South America itself, our researches indicate the former existence of a range connecting the Andes of Colombia with the mountains of western Panama and Costa Rica, and these in turn seem to have had a faunal relation with those of Mexico. Our field, therefore, reaches from one extremity of the Western Hemisphere to the other.

Since birds could not develop in space, it follows that the Andes have been populated from below upward. But in hunting for ancestral types we must consider not only place of origin but also the matter of habitat requirements mentioned in the earlier part of this article. That is, the ancestors of forest-frequenting birds must be looked for in other forests; those of the plains, in other plains. To illustrate: the tanagers, flycatchers, parrots, trogons, toucans, and other forest dwellers of the Temperate Zone, while very distinct, are all obviously descendants of forest-inhabiting ancestors. Similarly the ancestors of the finches and ovenbirds of Temperate Zone plains we should expect to find in other plains. The only available forests are those of the Subtropical and Tropical zones and the only available plains are those of the South Temperate Zone. As a matter of fact it appears that the Temperate Zone forest birds did originate in tropical forests while the Temperate Zone plains birds came from Argentina and Patagonia.

Here, then, we have a clue to the widely varying degree of distinctness

shown by the birds of the forested and treeless divisions of the Temperate Zone to which I have previously called attention. Obviously in extending their range from the Tropical to the Temperate Zone the tanagers, trogons, flycatchers, and other birds making this journey have experienced as pronounced a change in environment as though, let us say, they had gone from Ecuador to Ontario, and their differentiation from the ancestral type is correspondingly pronounced. But the birds that came from Patagonia, by increasing their altitude as they approached the equator have merely advanced from the South Temperate Zone to the Andean Temperate Zone, and thus, not having been subjected to marked environmental change, show comparatively slight differentiation from the ancestral type. It seems apparent, therefore, that the evolution of these forms is not a question of time or of distance from the point of origin, but of the extent of the change in surroundings to which they have been subjected.

This is the type of problem which we hope to solve by our explorations in the Andes. We are still on the threshold of our subject, but already we believe we have discovered in these mountains a biological laboratory where nature is conducting intensive experiments in distribution and evolution on a continental scale and producing results with such directness and rapidity that we may hope to gain an insight into the methods by which she operates.

The High Andes of Ecuador¹

EPISODES IN THE TRAVELS OF A MAMMALOGIST

By H. E. ANTHONY

Associate Curator of Mammals of the Western Hemisphere

HOMER tells us that when the giant sons of Poseidon, Otus and Ephialtes, warred against heaven, they planned to pile Ossa on Olympus and Pelion upon Ossa, attempting in this way to reach the abode of the gods. These mountains massed upon one another would have attained a height of a little more than 21,000 feet above the sea. If Homer had known of Ecuador, he could have pointed to Chimborazo as the fulfillment of this aspiration, for the snowy summit of this Andean peak towers almost 21,000 feet above the Pacific, and in very truth seems to raise its head to heaven. Nor in Chimborazo alone does one find evidence of a vast exercise of energy, for there are in Ecuador many lofty-crested mountains and elevated regions where the rough, wild topography, characterized by gaping craters and abysmal gorges, looks like a scarred battle field over which the gods themselves have struggled. And in a sense this impression is justified, for here the forces of vulcanism, the fires of the inner earth, have cast off the restraining hand of gravity and raised mighty mountain masses, or blown away into ash the rock which once filled the now dead or dying craters.

One of the features that will appeal to a climber of Ecuadorean peaks is the ease with which one may arrive at the base of a high mountain. It is possible to ride in a railroad coach across the very flank of Chimborazo. It is no less true, however, that one would still

find himself a long distance below the summit even then, for the elevation at Urbina, the highest point attained by the railroad, is 11,400 feet. Chimborazo has been scaled by but few persons,—a distinction it has maintained because of its great elevation rather than because of any prohibitive feature of topography.

The visitor to Ecuador takes the train at Guayaquil and in a comfortable coach soon finds himself leaving the tropical lowlands to enter the gorge of the Rio Chanchan. Higher and higher the engine toils, now in the heart of the western Andes, and for the greater part of the two days' ride to Quito, the end of the line, the traveler does not descend below 8000 feet. By marvelous feats of engineering the track climbs up over ridges and divides, follows up watercourses until the rivers dwindle to brooks and the brooks to mountain springs, and crosses elevated plateaus more than two miles above the sea. During most of this time, if the day be clear, one or more snow-clad peaks will dominate the horizon. In one ravine the engineers have been forced to ascend in a zigzag course, switching and running the train backward a short distance in order to reach the pass above.

During the field season of 1923 the American Museum Expedition to Ecuador visited several of the highest of these Andean monarchs and collected specimens right up to the line of perpetual snow. I was accompanied during this time by Mr. G. H. H. Tate,

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Up the ravine of the Rio Chanchan the trains of the Guayaquil and Quito Railroad puff their way, the heavy exhaust from the laboring engine roaring and echoing in the rocky defiles. Looking backward from the last coach, one sees an ever-changing panorama reminiscent of our own Royal Gorge

the field assistant of the department of mammals, and we secured such native help as was needed to tend camp, care for the pack animals, and perform similar services. Our headquarters were at Quito, where we had as host Mr. Ludovic Söderström, who has studied the natural history of Ecuador for more than fifty years.

Quito lies upon the margin of a vast interandean basin, rimmed by rugged peaks thrust upward from 16,000 to 19,000 feet. Fairly overhanging Quito is Mt. Pichincha, 15,918 feet¹ above sea level, which is easily climbed from this city. It is said that some men go up and back the same day, but most

climbers prefer to devote two days to the trip. Quito itself has an elevation of about 9400 feet and one can ride a good horse or mule most of the way from Quito to Pichincha.

The Museum party spent some days camped on Pichincha, the lower camp being at about 11,500 feet, the upper at 13,300 feet. The latter station was called Verdecocha, and here we were practically in the ancient crater of Rucu-Pichincha. The mountain has two peaks: one called Rucu-Pichincha, or the Old Pichincha; the other, Guagua-Pichincha, or Baby Pichincha—*guagua* being Quichua for baby. Strangely enough the Baby Pichincha is slightly the higher and takes its name from the fact that its crater still

¹All of the important elevations mentioned in this article are taken from the volume *Travels Among the Great Andes of the Equator*, by Edward Whymper.

steams and consequently appears to be younger than the burnt-out crater of Old Pichincha.

At Verdecocha we seemed to be atop the world. Soon after sunrise and before the clouds had swirled up from the valleys far below, it was possible to obtain glorious views of distant peaks. To the southward we could just catch sight of Chimborazo's rounded summit, but the finest spectacle lay to the eastward. Looking out from the grassy hillsides of Verdecocha one saw the swelling flanks of Pichincha running down to meet the parti-colored fields below, where green pastures alternated with thickets of scrubby brush or met the rectangles of ripened stands of grain in patterns like to the quilts our grandmothers made. To the right a long ridge dropped away to swing up again to the sky line at the summit of Mt. Atacazo, while Mt. Corazon peeked at one over the truncate summit of Atacazo. Across the Quito plain and the Chillo valley the stark outlines of Rumiñahui rose above a basal blanket of fluffy cloud, the long-dead crater at the summit cold and forbidding in the early light. Lowell's line about "burnt-out craters healed with snow" came to mind and we could not help wishing that such a ghastly scar on the earth's surface were concealed under a soft white bandage. As a background to the torn and gashed ramparts of Rumiñahui, the symmetrical outline of lovely Cotopaxi reached up and towered against the sun-flecked eastern horizon, a superb elevation of 19,613 feet. Antisana, to the north of Cotopaxi, 19,335 feet of snow-draped grandeur, and Cayambe, north of Antisana, 19,186 feet, completed a triumvirate of mountain peaks of unsurpassed splendor. All over the lower slopes of the mountain ridges

and billowing up out of hidden ravines and valleys the morning mists and white, night-heavy clouds stirred at the beckoning of the sun god and began the long upward struggle which brought them about our camp later in the day, when their clammy touch was poor fulfillment of the soft downy promise they gave in the far distance.

Our camp at Verdecocha was set on the grassy sod of a small valley which headed up against the high andesite cliffs of Rucu-Pichincha. Great condors wheeled majestically along these crags and sometimes perched on some out-jutting promontory to pass professional judgment on the two-legged creatures below. We were poor prospects, however, and the condors had little encouragement. Only by extreme good fortune, nevertheless, had the condors been robbed of a meal when some days previously we had moved camp up to Verdecocha.

With our camping equipment packed on four mules and ourselves riding two more, we had begun the climb from San Ignacio. We had completed about one-third of the distance when we had to swing north from the so-called trail—a mere bridle-path at best—and take to the crest of a steep narrow ridge, knifelike in its proportions. At the steepest point along this upthrust edge, one of the pack mules pulled back on the lead rope, jerked it from the hand of the *arriero* in a series of stiff-legged jumps, and disappeared over the edge of the ridge, amidst a wail of "Aye, Aye, Aye," from the Indians. We expected to see the animal rolling head over heels to certain death, for there was a continuous steep pitch for at least five hundred feet. Sounds of crashing impacts came to our ears but no mule appeared from behind the little shoulder immediately before us.

Then hundreds of feet below one of our pack containers flashed into sight. Whirling end for end, it touched the earth only to rebound in great leaps and I had a sickening vision of fractured cameras and ruined equipment. Even as we were looking, the pack caromed over a slight rise and vanished. Tate was certain that the pack had been completely destroyed and that the very bottom of the ravine had received the fragments, but I thought that it might have been checked by some low brush out of which I had seen nothing issue. I made up my mind that the mule was dead. And now follows a sequel hard to believe.

The mule had rolled about fifty feet, over and over, when it had managed to check its fall somewhat, but the strain had burst the pack harness, which slipped from the animal. The mule, freed of its burden, then came to a full stop and saved itself. The pack was made up of two square containers, one of which fell flat and stopped. The other was thrown on edge and given right of way to the bottom. Nearly a quarter of a mile down the slope I followed it, at first by means of the gashes it had made in the turf and earth, and then, as fastenings had given way, by means of sundry articles of equipment. My relief was great to discover that the pack was the one containing the kitchen equipment. Flour dusted the grass, rice was sprinkled lavishly under vegetation that never grew it before, while unrecognizable odds and ends festooned the margin of the course. Finally, the container had struck squarely against a small clump of brush and burst wide open. How I regretted our conservative use of eggs in the camp below when I saw the reckless way in which they were now distributed over the ter-

rain! Amidst all the wreckage one egg had preserved its integrity.

The errant mule was repacked with what could be salvaged of the cook supplies and the rest of the trip was one series of mishaps after another until long after sundown, when we pitched our tent at Verdecocha. How that mule escaped apparently certain disaster twice that day can be answered only by the special providence that watches over the destiny of these hardy Ecuadorean song birds.

We climbed to the crater of Guagua-Pichincha, on foot from Verdecocha, and after a long arduous ascent over a barren waste of ash, at an altitude that made climbing unusually tiresome, reached the lip of the vast cauldron, which steamed with sulphurous fumes. We could not see to the bottom on account of the dense vapor, but as far as the eye could penetrate, were huge blocks of andesite. It is possible to descend deep into the crater, and scrubby vegetation grows within where there is soil.

A later camp brought us near to the great bulk of Cotopaxi. The symmetry of Cotopaxi, while beautiful, does not have the grandeur that a more rugged character gives to such peaks as Antisana.

From our camp on a broad, ancient lava flow at Llavepungo, we could look across a wide stretch of beautifully green páramo to where the regular outlines of Cotopaxi were momentarily revealed by the kaleidoscopic shifting of heavy cloud masses. Although not very active volcanically now, Cotopaxi has erupted with considerable violence within comparatively recent times, and Whymper, the noted English mountain climber, who ascended the peak in 1880, comparing his measurements with those of earlier explorers,



COTOPAXI AT SUNRISE

It is characteristic of Ecuadorian skies that they are often clearest at sunrise. Sometimes the only glimpse one can get of Andean peaks is early in the morning. As soon as the sun's rays have warmed the night-chilled air, heavy banks of cloud envelop the mountain ranges and shut off the view. It was well worth the effort to arise early and leave one's tent to behold Cotopaxi at dawn. In the hush of the day's arrival—for here no call of tropical jungle denizen greets the sun—the vastness of the great distances is borne in upon the beholder with well-nigh overpowering force



Guagua-Pichincha rises sharply to an ash-rimmed crater. Within the crater the descent is equally abrupt. Upon the lip of this vast inverted cone the mountain climber is assailed from one side by faintly sulphurous steam, while from the other side the strong wind brings the billowing white clouds charged with refreshing ozone

concluded that Cotopaxi in the previous century and a half had built up its height about seven hundred feet.

Our most intimate association with high Andean peaks began when we hunted and trapped on the slopes of Antisana. Here all of our work was

done at elevations above 13,500 feet and up to 16,000 feet. Small rodents were trapped almost at snow line, about 15,500 feet, where there were scattered patches of low shrubs, grassy nooks, and low, dwarfed flowering plants. The flowers of these high



Short-stemmed white flowers, a species of the Compositæ, dot the greensward of Chimborazo near Urbina. Beautiful humming birds of many different species visit the blooms of these high mountain meadows



Although high elevation sets a limit upon plant growth, the foliage of Ecuador fights for the last inch. At Antisanilla, an elevation of 11,500 feet, the trees were stunted, but vines and ferns luxuriant



One of the most characteristic growths of the high mountain páramos is the hummock formed by close-set clusters of one of the wernerias. The foliage of this plant is rather hard and spinelike



The dwellers on the high Andean slopes encounter a problem in providing fuel. The only source of wood for fires is the low, dwarfed shrubbery scattered in favorable basins or pockets

elevations are especially interesting and occur in great variety. Many of them are species of the Compositæ and all are so dwarfed that they are practically stemless and grow close against the ground.

A large deer, quite similar in appearance to our Virginia deer, makes these high páramos its home, while a large tawny "wolf" ranges throughout the same region. Caracaras, which are large, strikingly marked hawks, walk

ON THE GLACIER OF
ANTISANA

The broad southern shoulder of Antisana bears a great glacier which is fed by perennial snows. This glacier is shaped by the sun into a rugged field of diminutive spires and chasms. On the surface the rotten ice, snow, and dirt form an opaque covering, and conceal the dangers of hidden crevasses. Whymper fell through this covering into a crevasse of this kind which he estimated to be seventy feet deep. Fortunately for him, he was tied by a rope to his two companions at the time. Under the surface the water from the melting ice drains away in tinkling rills



THE FRONT OF THE
GLACIER OF
ANTISANA

The glacier spreads out on the ash-covered slope of Antisana in a bold well-defined front. Streams milk-white in color, gush out from under the icy mass and wax and wane with the heat of the sun. At some places the glacier looms like a great white cliff, at least sixty or seventy feet tall, and the sheer sides of such a cliff, cleansed of the covering of rotted ice and snow, are translucent green. It is no easy task to scale this glacier wall, and one must seek a spot where the crumbling ramparts are least precipitous





The upper slopes of Antisana command a glorious view of mile upon mile of Andean scenery. Over most of the plateau lies a beautiful green covering of páramo grass inexpressibly restful to the eye. Distant peaks stand out in crystal clearness and mountains twenty miles away seem close at hand. Sincholagua in the foreground rises to a height of 16,365 feet, while Illiniza boasts an elevation of 17,405 cloud-piercing feet



About Punin, where the Museum party camped while excavating fossils, there was a large population of Quichua Indians, descendants of the Incas. Water being scarce and local, the Quichuas drove their flocks to a spring in a ravine, where countless rains had deeply eroded the volcanic beds, and where the bones of mastodon and saber-toothed tiger were mute witnesses to a former use of the spring

about on the green slopes; and along the numerous watercourses and boggy areas one meets with ducks, a large species of ibis known to the natives as *banduria*, and the clarion-voiced, spur-winged plover. When the sun shines brightly on this Andean upper-world, it is a region of fascinating beauty and attraction but, when the clouds drop low and the *guarua*, or mist, rides the land, the traveler draws his poncho closer and yearns for shelter and a fire.

There are many things to be written of Antisana, of the bold-fronted glacier that ever creeps down its southern slope, of the fierce wild cattle that roam from Antisana over into the jumbled mass of deep ravines and rugged peaks known as the Cimarrones, of the mountain lake that gives birth to the Rio Napo, and finally of Antisanilla near by, where for several miles one can trace an eruption of the past and note how a mighty volume of lava has poured forth, been checked in its flow by cooling, and frozen into the stream lines of its original course.

So many are the beautiful peaks of the Ecuadorean Andes the writer scarcely knows which to single out, and pages might be penned on the mountains seen from Antisana alone, from which the eye picks up a host of white

pinnacles against the horizon—Illiniza, Quilindaña, and Sincholagua, not to mention the better-known peaks, such as Cotopaxi, or the nameless ones of the wild hinterland to the southeast. But no account of the high Andes of Ecuador is complete without something about Chimborazo.

We spent several days at Urbina, where we were almost under the summit of Chimborazo. We were too close to appreciate the immense height of this mountain and, furthermore, the shepherds who have livestock on these high pasture lands were setting fires everywhere to burn away the old grass, with the result that the air was murky with smoke. To the north we could see Carihuairazo, a lesser brother of Chimborazo, but a high mountain in any company.



Canolestes fuliginosus is the scientific name of one of the most primitive of living South American mammals. It is a marsupial, distantly related to the opossums



The bleak cold which grips the páramos of Antisana whenever the sun does not shine calls for warm clothing. The shepherd of Antisana when he came out of the *hacienda* on a frosty morning looked as rough and shaggy as one of his own sheep. These people must be of hardy stock to withstand the constant hardships they encounter



Chimborazo standing out against a cloudless sky is far less impressive than Chimborazo bulking huge above the clouds, its shoulders parting the white masses

Our best view of Chimborazo we obtained from Punin, near Riobamba. Here, on a barren hillside, we could look out over a great stretch of desolate-appearing terrain, a rain-carved bed of volcanic ash, to where the mightiest of Ecuador's high mountains overtopped and dominated the land, seeming to hang in the very sky,—above the massive line of ridges which formed the backbone of the Cordillera, above the heavy banks of cloud which rolled along this mountain chain, above the highest of the lighter clouds that drifted in the upper air currents.

A number of high mountains lie to the east and southeast of Chimborazo, but lack of space forbids mention of

them by more than name. These include Sangay, sometimes spoken of as one of the world's most active volcanoes, El Altar and Tungurahua, all more than 16,500 feet and the highest more than 17,700 feet.

The great extent of high country in Ecuador forms a life zone of interesting characteristics, and the higher peaks such as Chimborazo, Antisana, and Cotopaxi, might be likened to high-altitude islands in a low-altitude sea. That is to say, the mammal life of the peaks is confined to its proper zone because, in attempting to migrate, the mammals must pass down into regions of lower altitude where the conditions are not so much to their liking. To



Although the clouds all too frequently shut out the mountains completely and thus destroy a view, no scene in the Andes is at its best without a proper cloud setting

many species a barrier of this sort, namely, an altitude difference, is not very effective, but other mammals are held as closely to these mountain areas as they would be to true islands by the surrounding seas. Isolation of this sort has brought about development of separate and distinct species of mammals on some of these peaks, and it was to determine the extent of this development of species that our season's work was planned. For example, large-eared mice of the genus *Phyllotis* were found only on the *arenales*, or ash-strewn crater slopes, and were not living on the great stretches of páramo which link the craters of the Andean system. In southern Ecuador, where

one is beyond the zone of high craters, this mouse has perforce had to adapt itself to lower elevations if it was to live in that region at all; there, accordingly, we find species of the same genus but quite distinct from the mountain-loving forms of the north. A very tiny deer, the Ecuadorean *Pudu*, is known only from high country near Antisana.

The working out of the problems of mammalian distribution furnishes the zoölogist with sufficient incentive to undertake expeditions into the field. When his field work brings him into a region of such fascinating possibilities as Ecuador, he finds his days are all too short, his visit terminates too quickly.

Frederic E. Church, Painter of the Andes

IT is fitting that a South American issue of NATURAL HISTORY should present some of the pictures of Frederic E. Church, for, although this artist in his search for the awe-inspiring and the beautiful, eternalized with his brush the fleeting glory of the northern lights, transferred to canvas the columnar stateliness and grace of the ancient ruins of Greece, and depicted the majesty of the irresistible sweep of waters at Niagara, it was the region of the high Andes that furnished the inspiration for several of his most notable paintings.

Telling effects produced by color—the dazzling beauty, for instance, of the rainbow hues that sparkle in the vapory dissolution of a waterfall, the misty softness of mountain valleys, and the dimmed brilliancy of the sullen red sun staring through the dark billowy swirl from a smoking volcano—are necessarily lost when a picture is reproduced in black and white, and yet it is the hope that the photographs—inadequate as they are—that appear in connection with this article may convey something of the beauty of the originals, or at least prompt those who are not familiar with the works of Church exhibited in the Metropolitan Museum and in the Public Library of New York, to seek their inspiration direct by a visit to these institutions. Nor should the opportunity be overlooked in this connection of studying the artist's work in the making by an examination of the preliminary sketches in pencil and *gouache* on view in the Museum for the Arts of Decoration at Cooper Union. To insure the attainment of the proper color values in the paintings subsequently prepared from these sketches, Church took the pre-

caution of indicating on a great many of the sketches the precise color desired. Thus one finds such jottings as "dazzlingly white," "dark blue shadow," "warm shadow, russet with reflected lights," "smoky orange," "buds and ends green gray," "remember the black rocks and brown grass," and the like. It is interesting to note that now and then in his South American sketches these jogs to the memory are in Spanish instead of English.

Church was born at Hartford, Connecticut, on May 4, 1826, and at an early stage of his development as an artist came under the influence of Thomas Cole, the founder of the Hudson River school of painting, that culminated in the art of George Inness, Alexander Wyant, and Homer D. Martin. Church went to live with Cole in the latter's house in the Catskills and worked under his precepts and influence until the time of Cole's death. Subsequently, in his search for ennobling scenes of nature, he visited many of the far places of the world, as a mere enumeration of some of his more important paintings will indicate: Falls of Tecendama (1854), Cotopaxi (1854), Mountains of Ecuador (1855), Niagara (1857), Heart of the Andes (1859), Twilight in the Wilderness (1860), Chimborazo (1864), Aurora Borealis (1865), Rainy Season in the Tropics (1866), Lava of St. Thomas, Jamaica (1867), The Parthenon (1871), El Khasna Petra (1872), Valley of Santa Ysabel (1875), El Ayu (1876), Morning in the Tropics (1877), The Monastery (1878), Valley of Santa Marta (1879), Ægean Sea, Damascus, Jerusalem, The Great Mountain Chain of New Granada, Morning on the Magdalena.



Courtesy of the Museum for the Arts of Decoration, Cooper Union

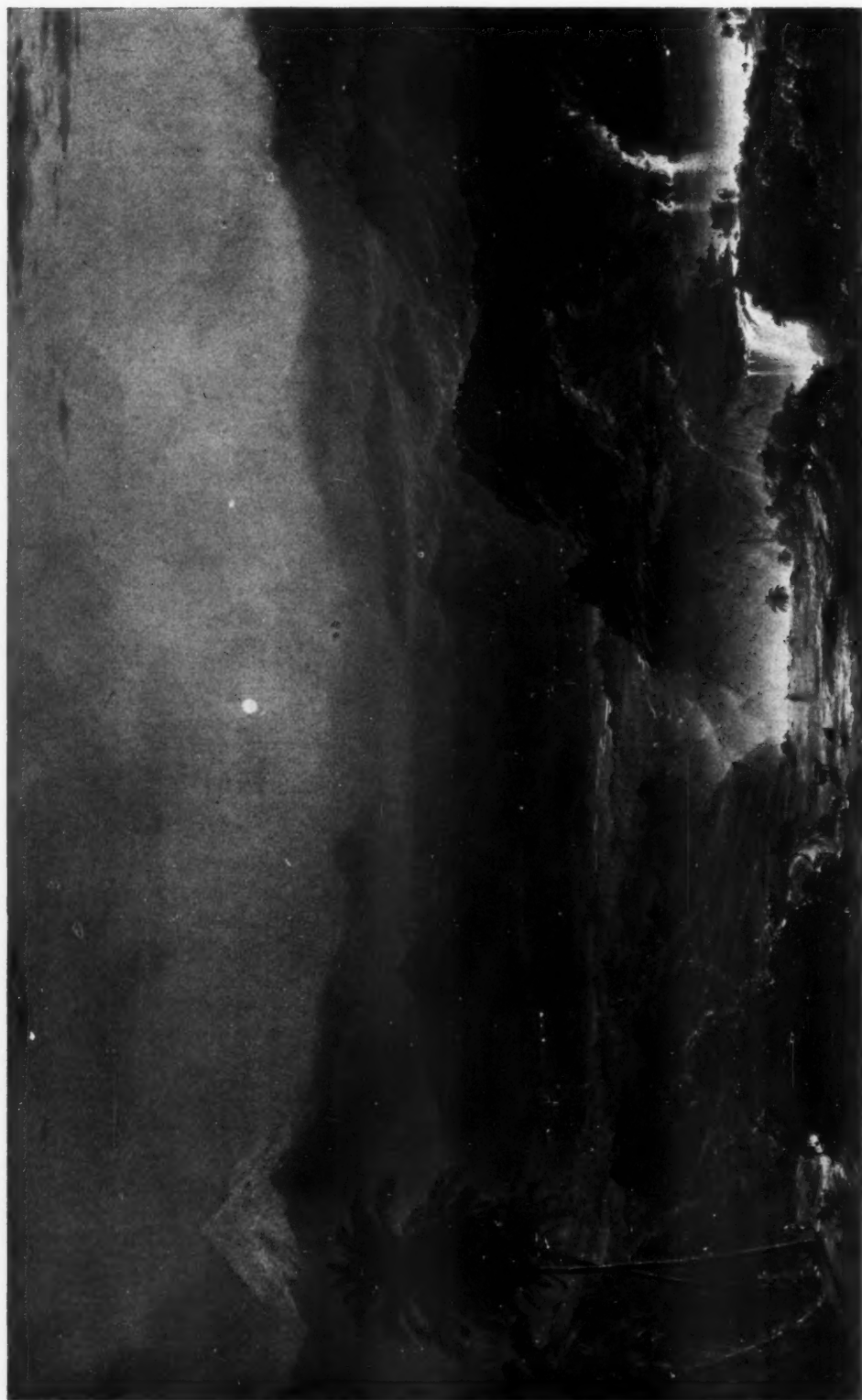
On July 9, 1857, Church started out from Riobamba for the volcano Sangay and was fortunate enough to obtain an unobscured view of it for twenty minutes just before sundown on July 11. He has left a record of his impressions in the sketch reproduced herewith. Supplementing this sketch, there is at Cooper Union a work sheet of the artist on which appear three rough drafts of the columns of smoke emitted by the volcano, with such notations for the artist's future guidance as, "2, smoky orange," "3, beautiful creamy white," "4, cloud pearly grey," and the like, the key figures referring to designated areas of the sketches

The preponderance, in this list, of South American subjects indicates the influence which that continent exerted upon the art of Church. Twice in the fifties he visited its west coast and has left in his journal an animated record of his experiences. That Church could paint with words as well as pigments, let the following extract witness. Reading it, one has the feeling that Church is setting down his impressions with quick verbal brush-strokes that nevertheless convey a vivid picture.

"My sketch finished, I turned my face, and Lo! Sangay, with its imposing plume of smoke stood clear before me. I was startled. Above a serrated, black, rugged group of peaks which form the crater, the columns rose: one creamy white against an opening of exquisitely blue sky—delicate white, cirrus-formed flakes of vapor hung about the great cumulous column and melted

away into the azure; the other, black and sombre, piled up in huge, rounded forms cut sharply against the dazzling white of the column of vapor, and, piled higher and higher, gradually was diffused into a yellowish tinted smoke through which would burst enormous heads of black smoke that kept expanding, the whole gigantic mass gradually settling down over the observer in a way that was appalling.

"I commenced a sketch of the effect, but constant changes rapidly followed and new beauties were revealed as the setting sun crested the black smoke with burnished copper and the white cumulous cloud with gold. At intervals of nearly four or five minutes an explosion took place; the first intimation was a fresh mass of smoke with sharply defined outlines, rolling above the dark rocks and followed by a heavy, rumbling sound which reverberated



Courtesy of Henry Fairfield Osborn

MOUNTAINS OF ECUADOR

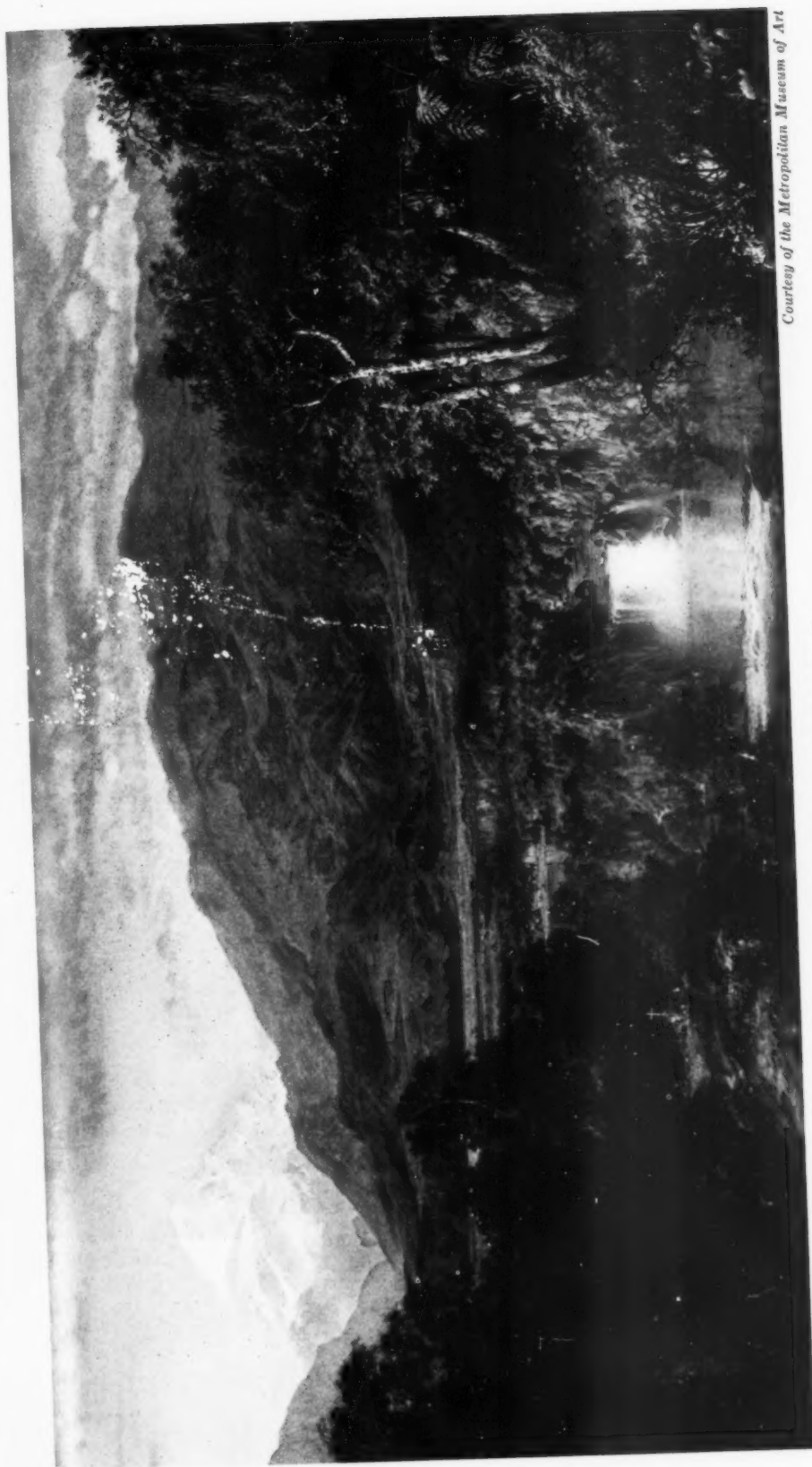


COTOPAXI



Courtesy of William Church Osborn

CHIMBORAZO



Courtesy of the Metropolitan Museum of Art

HEART OF THE ANDES

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Courtesy of Prof. Henry Fairfield Osborn

ALEXANDER VON HUMBOLDT

As he appeared at the time of his sojourn in Quito, Ecuador, in the early part of the nineteenth century

Alexander von Humboldt

SOUTH AMERICAN EXPLORER AND PROGENITOR OF EXPLORERS

THE greatest scientific traveller who ever lived" and "the parent of a grand progeny of scientific travellers" were the terms Darwin thought fit to apply to Alexander von Humboldt in writing to J. D. Hooker in 1881. Humboldt had then been dead nearly a quarter of a century; and more than eighty years had elapsed since in the ardor of young manhood he had set forth with the botanist Bonpland on their voyage of discovery in the New World.

Sailing from Spain on June 5, 1799, and making stops at Teneriffe and at Cumana, Humboldt and his companion ultimately reached Caracas and from there, early in 1800, undertook their eventful trip into the interior, exploring the course of the Orinoco and tracing the network of rivers that finally link this great stream with the Amazon system. Four months were consumed in the journey, in the course of which the adventurous travelers penetrated the forests that lie between the Rio Negro, the Orinoco, and the Amazon to a depth five hundred miles greater than that previously attained by Löffler.

After a sojourn of several months in Cuba, Humboldt and Bonpland set sail in March, 1801, for Cartagena on the north coast of South America and made their way up the Magdalena River and across the cold wind-swept heights of the Cordilleras to Quito in Ecuador, where they arrived in January of 1802. In and about Quito the travelers made their abode for nearly eight months, during which they ascended the volcanoes of the region. Pichincha, Cotopaxi, Antisana, and Ilinica were

studied; analyses were made of their gases, and measurements of their height and crater circumference were taken whenever it proved possible to do so. On June 9 the ascent of Chimborazo was attempted. The Indians that accompanied Humboldt, Bonpland, Carlos Montufer, and one of Humboldt's attendants on this exhausting climb, deserted before the final stage, declaring that the white men were trying to kill them in urging them on. Humboldt and his companions continued alone, weary but hopeful, until an impassable chasm blocked their ambitious effort and robbed them of the conquest of the summit.

The South American explorations of Humboldt were rounded out with the journey which he and Bonpland undertook by way of Riobamba and Cuenca to Lima, in the course of which they spent a month near the headwaters of the Amazon.

It has been possible to give only the barest outline of Humboldt's wanderings in South America, and to try to indicate the results of his explorations within a brief article presents even greater difficulties. In one of his letters Darwin speaks of him as "more remarkable for his astounding knowledge than for originality." It is because of the vast scope of his investigations—as comprehensive as his mentality—that it is hard to attempt even a summary of his work. Accustomed to the restrictions of an age of specialization, one feels amazement that Humboldt could apply geology, astronomy, meteorology, zoölogy, botany, and even linguistics in passing judgment upon the different phenomena that

came under his observation. His painstaking study of the volcanoes of the New World was perhaps his greatest contribution to geology. His observations of the remarkable meteor shower at Cumana on November 12-13, 1799, laid the foundations of our knowledge of the periodicity of this phenomenon. He studied the effects of guano on the productivity of the soil, and to his writings is due largely the fact that this fertilizer was introduced into Europe. His researches on climate, pursued with vigor during the South American journey, were of the greatest scientific importance. Darwin wrote: "I have always looked at him as, in fact, the founder of the geographical distribution of organisms;" and in delivering this opinion gave recognition to one of Humboldt's principal claims to greatness. Three folio volumes of geographical, physical, and botanical maps; twelve quarto volumes, devoted to the nonbotanical results of the trip; and thirteen folio volumes regarding the botany, as well as many smaller publications, furnish additional evidence of the magnitude and significance of Humboldt's exploratory work in South America.

At the beginning of this article citation was made of Darwin's designation of Humboldt as "the parent of a grand progeny of scientific travellers." Of this progeny Darwin himself was the favored son. The inspiration of Humboldt's example had a determining influence upon his life. Writing to Wallace in 1865 regarding the progress of Wallace's journal of travels, Darwin remarks:

"I have always thought that journals of this nature do considerable good by advancing the taste for Natural History; I know in my own case that nothing ever stimulated my zeal so

much as reading Humboldt's *Personal Narrative*."

In another connection he makes this statement:

"During my last years at Cambridge, I read with care and profound interest Humboldt's *Personal Narrative*. This work and Sir J. Herschel's *Introduction to the Study of Natural Philosophy*, stirred up in me a burning zeal to add even the most humble contribution to the noble structure of Natural Science. No one or a dozen other books influenced me nearly so much as these two."

One might go on quoting other references to Humboldt scattered through *The Life and Letters of Charles Darwin* and *More Letters of Charles Darwin*. Not all of these are so laudatory as the excerpts just given. In one Darwin expresses a certain degree of disappointment upon meeting Humboldt personally; in others there is qualified praise or divergence of opinion from some of Humboldt's scientific conclusions. Yet such phrases as "I venerate him" and a reference to Bates as "second only to Humboldt in describing a tropic forest" indicate Darwin's high estimate of his predecessor in the South American field.

The influence of Humboldt upon Darwin can be traced, furthermore, through the dozen or more references to him that occur in the South American portion of Darwin's *Voyage of the Beagle*. Imbued with the writings of Humboldt, Darwin compares his own observations with those recorded by the earlier scientific traveler or enters into brief discussions regarding the validity of his conclusions.

That the appreciation was not altogether one-sided, however, is evident from the following letter, which Humboldt wrote to Mrs. Austin some eight

years after the "Beagle," its five-year cruise completed, had put into Fal-mouth:

"Alas! you have got some one in England whom you do not read— young Darwin, who went with the expedition to the Straits of Magellan. He has succeeded far better than myself with the subject that I took up. There are admirable descriptions of tropical nature in his journal, which you do not read because the author is a zoologist, which you imagine to be synonymous with bore. Mr. Darwin has another merit, a very rare one in your country—he has praised me."

The concluding sentence throws an interesting sidelight on Humboldt, whose vanity was so frank that it disarmed criticism, while the general tenor of the letter reveals another and more pleasing trait, namely, his generous encouragement of young scientists.

While Darwin was the heir apparent in that "grand progeny of scientific travellers," one must not omit mention of another nature student of conspicuous rank, Louis Agassiz, who came under the influence of Humboldt. Agassiz records that when he was a student at Munich he was filled with a passionate desire "to accompany Humboldt on his projected trip to Asia." Denied the realization of this ardent wish, he nevertheless had the opportunity later of meeting Humboldt and of learning from him "How to work, what to do, and what to avoid; how to live; how to distribute my time; what methods of study to pursue." In subsequent years Agassiz himself explored the Amazonian valley, passing so near the scene of Humboldt's field researches that he was able to check up his own results with those recorded in Humboldt's narrative and to recognize the extent of the great

traveler's knowledge and the comprehensiveness of his views, even in cases where the progress of science led to a different interpretation of the facts.

A man whose fame in his own day was second only to that of Napoleon was naturally a favorite subject for portrait painter and sculptor. There is a statue of Humboldt in Central Park, and within the American Museum there are two reminders of him,—the bust by William Couper that occupies a niche in Memorial Hall and the painting by Julius Schrader that is on the left of the visitor as he steps out of the elevator on the second floor. This portrait, depicting Humboldt in old age (the very year of his death, 1859) but against a background of snowy peaks associated with his youth, is reproduced on p. 452. Among others who had the privilege of painting Humboldt in advanced life were Karl Begas, who made the celebrated portrait of him for the Gallery of Knights of the Order of Merit, Eduard Hildebrandt, and Madam Emma Gaggiotti-Richards—a young Italian artist of talent, who resided in Berlin during the closing years of Humboldt's life. It may not be without interest to quote from the record left us by the artist M. Wight, to whom Humboldt accorded sittings in 1852.

"Humboldt was at that time eighty-three years of age. The first interview was on the occasion of his sitting for the portrait in February of that year [1852]. I found him a man rather below the medium stature, dressed with the utmost simplicity, in black. His step was moderate, but firm and decided, with his head a little inclined forward. In conversation his face would glow with enthusiasm, and his small clear eyes sparkle with animation. He was apparently very tena-



PORTRAIT OF BARON ALEXANDER VON HUMBOLDT

PAINTED BY JULIUS SCHRADER

In the year 1857 Mr. Albert Havemeyer, of New York, being then in Berlin, called on Humboldt, then in his eighty-ninth year, and requested him to allow his portrait to be painted. Although the Baron had declined frequent solicitations for a similar favor, he was made to feel that his many personal friends in the United States would be gratified by his compliance and he consented to have the eminent artist, Julius Schrader, paint the picture here shown. The background was of his own selection, his remark to the artist being, "I will be painted sitting here," designating the spot with Chimborazo in the distance. The artist commenced the picture at once and at its completion in 1859 the Baron expressed himself as well pleased. It is Humboldt's last portrait and has been copied many times. It was presented to the American Museum by Mr. Morris K. Jesup and hangs above the president's office on the second floor.

cious of his time. There were five sittings. I found him always prompt to the minute. Knowing that he had received several decorations from crowned heads, I asked him if he wished me to represent any of them in his portrait; he replied that he preferred it should be painted without any ornament whatever."

The concluding sentence is of interest, for in the portrait by Julius Schrader, there is a similar absence of insignia.

More interesting from our standpoint than the pictures of the mature scientist—the man acclaimed by the world—is the portrait in color that serves as the frontispiece of this article, showing the explorer in the full vigor of his adventurous young manhood, at a time of life when he was making the discoveries and gathering the materials that, subsequently worked up, were to establish his fame. This painting, the work of a South American artist, Rafael Sabas, was secured by Frederic E. Church during one of his trips to the west coast of that continent and was subsequently presented by Mr. Louis P. Church to Prof. Henry Fairfield Osborn, by whose courtesy it is here included. The picture was executed in 1859 and bears the inscription that it is a faithful copy of a portrait of the explorer painted at Quito by José Cortes early in the century, at a time when Humboldt was climbing the snowy peaks of Ecuador and studying the volcanoes. Among those who went up Chimborazo with Humboldt was mentioned Carlos Montufar of the distinguished family of Aguirre y Montufar, with the members of which Humboldt was on intimate terms. Two of the ladies of this

family were still living in 1859, and although more than half a century had elapsed since the time of Humboldt's visit, they had vivid recollections of the young explorer. Prof. Moritz Wagner interviewed them in that year, and in his account there is a reference to a portrait in the possession of the family. The reader is invited to compare Wagner's minute description of it with the details of the frontispiece of this article and see for himself whether it is not probable that the painting described served as the model for Rafael Sabas' copy, which might still be referred to as faithful even though some minor details—for instance, the book—have been omitted.

"The family of Aguirre have still in their possession a half-length portrait, life-size, of their distinguished guest, painted by a native artist, which is preserved in their country house of Chillo, half a day's journey from Quito from whence Humboldt used to make excursions in the pursuit of geology and botany. The young German baron, at that time (in 1802) thirty-three years of age, is represented in a court uniform of dark blue with yellow facings, a white waistcoat, and white breeches of the fashion of the last century. His right hand rests upon a book entitled *Aphorism, ex Phys. Chim. Plant.* His thoughtful brow is covered by long dark brown hair. The features in the youthful face are strongly marked, especially the nose, mouth, and chin. The peculiar expression of the eyes is the point of resemblance most readily traceable in this picture to Humboldt as I saw him fifty years later, then a venerable old man."



A SCENE IN THE VILLAGE OF BAÑOS, PROVINCE OF TUNGURAHUA

The climbing plant which covers the balconies of the small house in the foreground is *Passiflora ligularis*, the common granadilla. Its hard-shelled fruit, the size of a hen's egg, contains translucent pulp of delightful flavor and delicate aroma

Hunting New Fruits in Ecuador¹

By WILSON POPENOE

Agricultural Explorer, U. S. Department of Agriculture

THE principal civilized peoples of pre-Columbian America,—Aztec, Maya, and Quichua,—were agriculturists of no mean order. Remarkable skill was shown by the Quichua, who converted into productive land the barren mountain-sides of their Peruvian home. On these rocky slopes they built series upon series of stone terraces, filled them with rich alluvium from the fertile valleys below, and irrigated them artificially from the mountain streams above. They brought many wild food plants into domestication and through conscious or unconscious selection carried some of them to a high degree of agricultural excellence, with the result that such plants as the potato and the sweet potato, the tomato, and the peanut are now cultivated and prized in many parts of the world.

We may be in danger, however, of giving the Quichua agriculturists too much credit. Perhaps they were fortunate, above other American peoples, in occupying a region where wild plants of potential economic value were particularly numerous. Even after many centuries of Quichua occupation, and the domestication of more than a score of plants, the highlands of Ecuador and Peru still contain many wild species of horticultural promise. It is this fact, together with the added circumstance that numerous cultivated plants of the Quichua have not yet received attention in other parts of the world, that makes the Andean region extremely attractive

as a field for agricultural exploration.

One whose interests lie along pomological lines cannot imagine a region more replete with thrills than Ecuador. To begin with, there exists near Naranjito, not far from Guayaquil, one of the most remarkable collections of Asiatic fruits in South America. In fact, the only bearing mangosteen trees on the continent are to be found at this place—the Hacienda Payo. Those familiar with the mangosteen need not be told that it is the queen of fruits, and that it has long been famous as one of the finest products of the Malayan region. In relatively recent years, it has been transplanted to the West Indies, where a few trees are now in bearing.

During the first years of the present century, the elder Madinyá, owner of Payo, occasionally made trips abroad and, returning to Ecuador, brought with him seeds and plants of many rare fruits secured through nurseries in France and the West Indies. Besides the mangosteen, he established in Ecuador the litchi, the rambutan, and the carambola—all Asiatic fruits of extraordinary merit, little known in America.

Even more interesting than these are the native species which are found, wild or in cultivation, in the Ecuadorian highlands. Chief among them are the cherimoya, the capulí, the Chilean strawberry, the babaco, several blackberries and raspberries, and the naranjilla.

For years I have been familiar with the cherimoya. It is cultivated in

¹Photographs by the author.

Mexico and Guatemala, and excellent specimens have been produced by trees planted in southern California. Not until I reached Ecuador, however, had I seen the cherimoya in its native home. As a wild tree, it grows in profusion along the valley of the Rio Malacatos, at the southern end of the country, and in neighboring parts of Peru. From this region it was carried to southern Peru probably before the arrival of the Spaniards, who took it northward to Central America and Mexico.

The cherimoya is a remarkable fruit. It has often been described as vegetable ice cream, because of its white flesh, which has the consistency of a firm custard, and is strikingly suggestive of delicate ice cream when



The cherimoya has been termed a "master-piece of nature." For its luscious flavor, suggesting a combination of pineapple, strawberry, and banana, and the smooth texture of its white pulp, which suggests ice cream, it is entitled to rank among the best fruits of the tropics. Its native home is in southern Ecuador and the neighboring parts of Peru

chilled and served as a dessert. It has the combined flavors of pineapple, strawberry, and banana, and for sheer lusciousness is excelled by few other products of the vegetable kingdom. The cherimoya tree can be grown where the lemon flourishes. Its cultivation in California has proved practicable, but the several small orchards which have been established in that state have failed to yield their owners profitable returns, due to the fact that they have borne very scantily. The pollination of this fruit under cultivation in the United States will have to be solved before the cherimoya can become a familiar sight in our markets.

Blackberries and raspberries are generally looked upon as northern fruits. At least, this had been my own impression before visiting the Andean region, where I found to my surprise berries vying in excellence with the best produced in the United States.

Two years before visiting Ecuador, I had seen in Guatemala a remarkable berry, known to the Indians of that country as tokán uuk. The plant resembled a raspberry in growth and appearance, while the fruit was like our loganberry but less tart in flavor. On reaching the Ecuadorean Andes, I found this same species, *Rubus glaucus*, playing the rôle of an important cultivated plant in the gardens of many highland towns. In fact, the *mora de Castilla*, as it is there called, may be considered one of the favorite fruits of the Ecuadorean highlands.

Just why this berry has never received horticultural attention in other countries is beyond my comprehension. It is too fine a thing to be overlooked by any one who has an eye for fruits and, unlike certain other plants of the Ecuadorean Andes, its propagation is simple. To the end that it might be

popularized, the Department of Agriculture propagated a large number of plants from seeds I secured in Ecuador and has distributed them in those parts of the United States where they seem likely to thrive. Already the Andes berry, as we have decided to call the *mora de Castilla*, has borne fruit in California and is doing well in the Gulf States and in the Southwest

occasionally seen in cultivation. Neither of these, however, is superior to the typical form.

Seventy years ago the English botanist Richard Spruce spent several years in the Ecuadorean Andes. He had been collecting in the Amazon Basin, where he did a remarkable piece of pioneering work. At the request of the British government, he came up the



The town of Baños, which lies at the foot of the volcano Tungurahua, is one of the most picturesque in the Ecuadorean Andes, and a classic resort of naturalists since the days of Richard Spruce. Close by are the magnificent falls of Agoyán. The Pastaza River, which flows past the town, is a tributary of the Amazon

generally. It is remarkable for its immense growth, as well as for the fine quality of its fruit. A single plant will cover the side of a small house or, if left to itself, will form a mound of verdure ten feet high and fifteen feet in spread.

Under cultivation in Ecuador several horticultural varieties have originated. The common, or wild, one has berries of deep maroon color. A rose-red variety and a light pink one are

eastern slope of the Andes to Ambato and then went southward to Loja Province, where he carefully investigated the source of quinine, with a view to obtaining seeds of the trees which yield this product. His labors during a period of more than two years and his final success in transplanting the best quinine-yielding species to India form a romantic chapter in the history of plant introduction. Present-day botanical explorers who complain



The moist, fertile slopes of the Ecuadorean Andes are cultivated up to elevations of 12,000 feet. This photograph shows a prosperous agricultural community near El Angel, province of Carchi. The principal crops grown in this region are barley and potatoes

of the discomforts suffered in crossing the Andes should read Spruce's notes, and reflect upon the difference between Andean travel in the middle of the last century and that of today.

During his stay in Ambato, Spruce was struck by the excellent quality of the strawberries grown in that region and by the fact that they were on the market every day in the year. He told of large fields devoted to this plant near Guachi. This region still produces strawberries in abundance, and the traveler to Quito is certain to be greeted by the sight of large baskets of them, no matter what day or month he passes through Ambato.

The casual tourist assumes that these berries are of the same species as those grown in the United States. He does not know that they represent the Chilean strawberry, *Fragaria chiloensis*, which is cultivated only in South America. In 1714, a Frenchman named Frezier, who was voyaging on

the Pacific, secured a few plants of this berry at Concepción, Chile, and carried them with him to Marseilles. Their progeny, when crossed with the small-fruited strawberries then cultivated in Europe, yielded the first large-fruited strawberries of the type now grown both in Europe and America. There is a Chilean strain, therefore, in our own cultivated varieties, but the fraction is probably a small one.

Previous to the Conquest, this berry was not known in Peru or Ecuador. It was carried to Cuzco shortly after the Spanish established themselves in that city, and later was taken to Ecuador, where it has been cultivated ever since and held in high esteem.

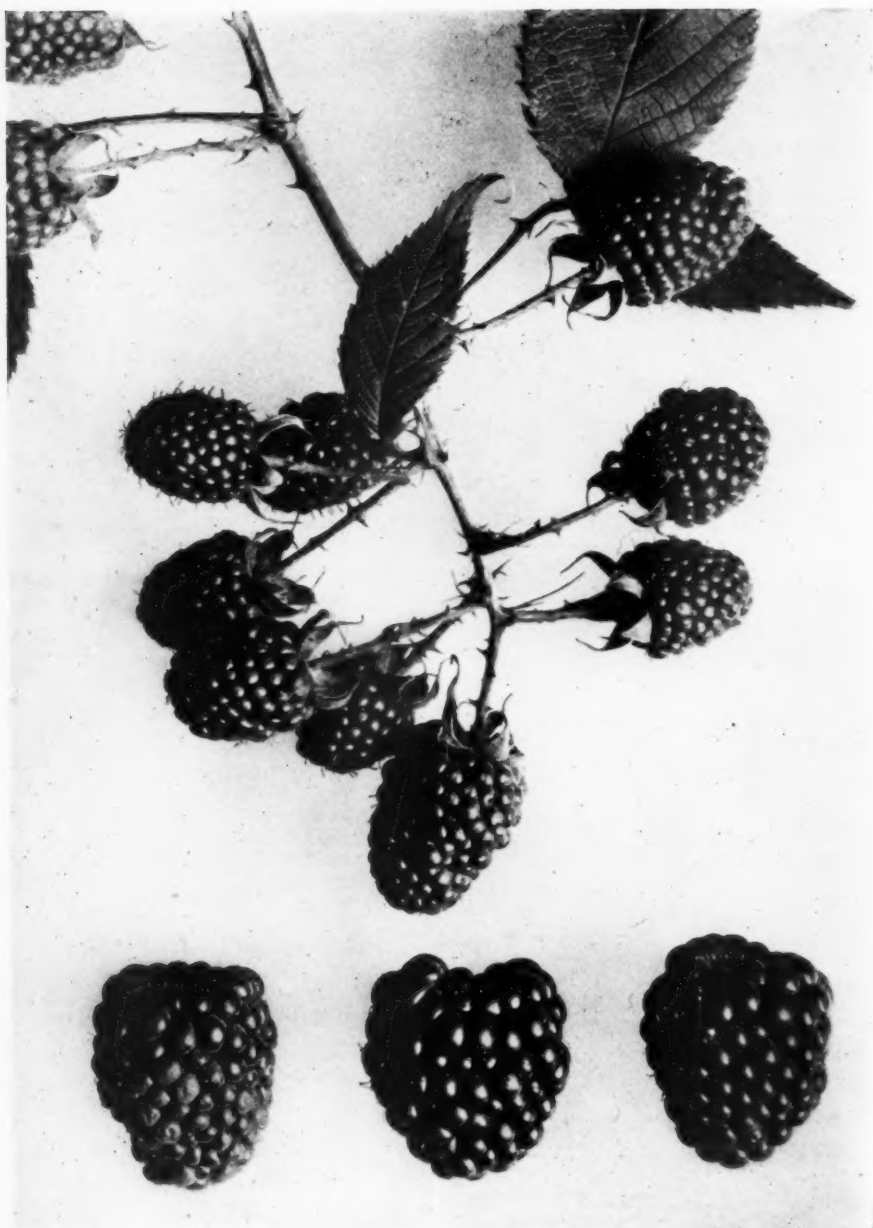
The Chilean strawberry is rather exacting in its requirements. It does not tolerate a moist climate. In Ecuador it bears all the year round, but this is not the case either in Peru or in Chile. This peculiarity can be attributed, therefore, to the lack of seasonal



A sphagnum bog on the páramo near El Angel, province of Carchi, at an elevation of approximately 13,000 feet. This is typical páramo scenery; the two characteristic plants are ichu, the bunch grass shown in the foreground (botanically *Stipa ichu*); and the thick-stemmed composite which fills the background, a species of *Espeletia* known locally as frailejón



Strawberry pickers at Guachi, near Ambato.—Large fields are given over to the Chilean strawberry (*Fragaria chiloensis*) in this region. The fruits, which are of good size and flavor, are remarkable for their ability to withstand shipment. They ripen throughout the year, and are grown on sandy soil without irrigation in a region where the annual rainfall is scarcely more than eighteen inches



THE ANDES BERRY

Rubus glaucus grows wild in mountainous regions from southern Mexico to Peru. It is cultivated in Colombia and Ecuador, where its dark maroon, juicy, richly flavored fruits are highly prized. They are used like northern loganberries, which they resemble except for the fact that they are sweeter in flavor and slightly different in form. (Natural size.)



CLUSTERS OF CAPULI

A cultivated form of the black cherry, *Prunus serotina*, is commonly grown in Mexico, Guatemala, Colombia, Ecuador, and Peru. Ecuador possesses better varieties than other countries; the one shown here, from Ambato, has fruits as large as California oxheart cherries, and of excellent flavor. (Natural size.)



THE ANDEAN BLUEBERRY

Vaccinium floribundum, called mortiño in Ecuador, grows profusely in northern South America at elevations between 10,000 and 12,000 feet. Its small fruits, while not more than a quarter of an inch long, are of pleasant flavor. The pink flowers and deep green foliage give the plant a handsome appearance. (Natural size.)



The granadilla de Quijos (*Passiflora popenovii*) grows along the tributaries of the Amazon in eastern Ecuador. It has flowers of unusual beauty, white, blue, and lilac in color, followed by good-sized oval fruits of delicate and aromatic flavor. (Natural size.)

changes in the Ecuadorean climate. Plants yield freely when grown without irrigation on the sandy plains of Guachi, but when grown on good garden soil and watered frequently, the berries are few, small, and of inferior quality. At Guachi they are usually an inch and a half long, of remarkably firm texture, and of sweet and peculiarly aromatic flavor. The texture is a characteristic of extreme value to plant breeders, for North American strawberries are much less firm and do not stand shipping nearly so well. It is for this reason that several breeders in the United States are now working with the

Chilean strawberry in the hope of securing, through crossing it with our own cultivated sorts, varieties adapted to our climate, yet having the texture of the Chilean form.

The traveler in the Ecuadorean Andes—the region popularly referred to as the “Sierra”—soon becomes familiar with the capulí, a tree seen about cultivated places from one end of the country to the other. Teodoro Wolf, who spent twenty years in Ecuador and wrote an excellent book regarding the country, spoke of the capulí as characterizing the Andean region just as the coconut palm is typical of the coast.

I do not believe the capulí is indigenous to Ecuador, in spite of the fact that Ecuadoreans commonly claim it as their own. Strangely enough, it is a southern form of a plant well known in the eastern United States, extending as far north as Nova Scotia, —*Prunus serotina*, the wild black cherry of this country. History records



The babaco (*Carica pentagona*), closely related to the papaya of tropical regions, is cultivated in numerous highland towns of Ecuador. The plant resists light frost, and the yellow fruits, which attain a foot in length, are made into an excellent preserve

that the Spanish first took it to Peru, where it is now as common as in Ecuador. In both these countries it is known under a name taken from the Aztec language, and its cultivation by that people in pre-Columbian days is a recognized fact. Assuming, therefore, that this plant was carried to Ecuador from Mexico, it is interesting to note that the first-named country now produces much finer capulís than does the

native home of the species. I have never seen in Mexico or in Guatemala capulís more than half the size of the most luscious grown in Ecuador, nor any half so good. The Ecuadorean capulí at its best is a fruit nearly as large as the oxheart cherry of the Pacific Coast. It is borne in clusters of from two to ten, and is juicy, sweet, and pleasant to eat. How well I remember the afternoon spent by Abelardo Pachano, José Antonio Montalvo, and myself under the famous Gonzales capulí tree near Ambato! We picked and ate the fruits until we could eat no more, and I was convinced that the capulí is worth cultivating not only in the southern United States but also in all subtropical regions where European cherries do not succeed.

Ambato is the center of the greatest fruit-growing region in Ecuador and, because of its dry and relatively cool climate, it is suited to the cultivation of many temperate, as well as subtropical, species. Its elevation of 8000 feet will not permit the rearing of strictly tropical fruit-bearing plants since light frosts occur every once in a while.

In Andean villages several remarkable species of *Carica* are cultivated. These are related to the common papaya of tropical countries but, unlike the latter, will resist frost. The best of them is the babaco, grown principally in the Ambato region, but occasionally at Quito and elsewhere. The babaco is produced by a half-woody plant that attains a height of ten feet. The fruit is cylindrical in form, nearly a foot in length, and suggests a muskmelon in character. It has highly aromatic flesh and a large hollow cavity in the center, which one would expect to contain many seeds but which rarely has any at all. In fact, the babaco is a curiosity. The two sexes

are or should be found in different plants. The pistillate, or female, plants bear fruits. In spite of having searched extensively, I have never found a single staminate, or male, plant. Apparently, the flowers produced by pistillate plants are never properly fertilized and, in consequence, no seeds develop. The usual thing in such cases would be that fruits also would fail to develop, but the babaco does not conform to the general rule in this respect.

Throughout the highlands are to be seen trees of a wild walnut, which resembles in foliage as well as fruit the black walnut of the United States,—more particularly that of California. The Ecuadorean species, *Juglans honorei*, however, is quite distinct from those of the United States. Its thick-shelled nuts contain richly flavored meats, which are made into delicious sweets by Ecuadorean housewives.

Most of the avocados grown in the Ecuadorean highlands are of the Mexican race, probably introduced by the Spanish in early days. There is an old tree in the Patate Valley, not far from Ambato, which, it is believed, was planted more than two centuries ago by Jesuit priests. *En passant*, it is worth mentioning that the priests and friars, who came to the New World along with the Conquistadores, were active in establishing the best European fruits and other food plants wherever they went, and in transporting native species, such as the avocado and the capulí, to regions where they had not previously been grown.

While at lunch one day in the Metropolitan Hotel in Quito, I was told by a fellow-traveler that the Chota Valley produced avocados of superior quality. Having found no avocados of value in

Ecuador up to that time, I was loath to believe the story but unwilling to ignore it. So I rode to Ibarra and thence down to the Chota River, notorious as a hot and malarial region. I was rewarded by finding avocados of unusual character and quality. Three trips to the Chota resulted in my securing budwood of the best varieties and introducing five into the United States, where they are now being tested.

In the Chota Valley is another excellent fruit, cultivated elsewhere in Ecuador but not in such perfection. It is the pepino, related to the potato and the eggplant. The elliptic greenish-yellow fruits sometimes attain the size of small cantaloupes, and strongly suggest the latter in flavor. They are produced by plants which look like potato vines but live for three or four years and bear fruit during most of that time.

Another member of the same family popular in Ecuador and little known elsewhere, with the exception of Colombia, is the naranjilla, botanically known as *Solanum quitoense*. This fruit, which has the size and appearance of a small orange (whence the name *naranjilla*—little orange) is borne by a half-shrubby plant with enormous hairy leaves. The fruit is used to prepare *refrescos*, or cooling drinks, which suggest in flavor a mixture of pineapple and lemon. Attempts to grow the naranjilla in Florida have been unsuccessful. For some reason as yet unknown to us, the plant does not bear fruit in that state, though it grows quite satisfactorily.

Colombians, to a greater extent than Ecuadoreans, appreciate and use the tacso, but the latter are by no means blind to its merits. This fruit, which belongs to the passion-flower family, is of the size and shape of a small

banana. It contains numerous seeds, each surrounded by juicy, acid pulp of aromatic and somewhat acid flavor. In Bogotá, housewives put this through a sieve and by adding sugar and milk make a delicious sherbet, which they

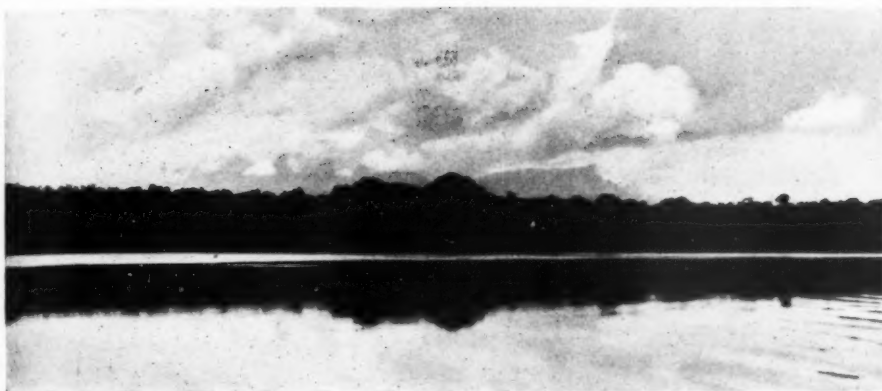


The favorite tacso of the Andes, *Passiflora mollissima*, is produced by a handsome vine, and is used to prepare excellent ice creams and desserts. Its orange-colored pulp is acid and highly aromatic

call *crema de curuba*. I did not come across this dish in Ecuador nor the equally delicious ice cream which can be made from ripe tacsos. Both for its fruit and the ornamental appearance of the vine, the tacso is worth cultivating

extensively in California, where it has already been tried and found to succeed.

The Spanish early brought their own fruits to Ambato, and the descendants of the original trees are seen everywhere in that region. Peaches, apples, plums, and apricots are abundantly produced, while a few miles farther down the Patate River are small orchards of citrus fruits. Nowhere in the higher Andes, however, are good oranges produced. A few spots, such as the warm Chota and Guailabamba valleys, are favorable for orange culture, but the best region is on the coast. Ecuador can produce excellent citrus fruits and some day may rank among the countries which export them. Ever since the production of cacao became less remunerative, due to increased plantings in Africa, Ecuadoreans have realized the necessity of diversifying their crops. Even now there is a small export trade in bananas, oranges, and pineapples, particularly the first-named, which are being grown on an ever-increasing scale for shipment to Peru and Chile. The pineapples of Guayaquil are famous; indeed, they probably equal in quality those of any other region, and they excel most. Fruit culture has come to the fore as one of the most likely sources of income, and within the next quarter of a century serious attention will certainly be devoted to the establishment of fruit industries both in the highland regions and along the coast.



The last gleam of the setting sun leaves a narrow pathway of molten silver between the unbroken darkness of the forest wall and its mellowed reflection. Even before the fast-moving clouds have cleared the ridges of distant Kamakusa mountain, this glistening streak will have been blotted out by the spreading darkness. What great discoveries still await the adventurous traveler below the canopy of forest that stretches for more than a thousand miles into the farthestmost limits of the valley of the Amazon!

Into the Interior of British Guiana¹

By HERBERT LANG

Associate Curator, African Mammals, American Museum

FEW other parts of South America can boast a more romantic history than the Guianas. Even today the lure of riches easily attained there still claims its victims. Far back, in the year 1616, so well seasoned a knight as Sir Walter Raleigh was blinded by the dazzling tales of the fabulous wealth of that phantom city of "El Dorado." Apart from personal disillusion and failure in his particular quest, his last heroic efforts were not altogether in vain. Did he not whet the appetite for the proverbial wealth of these lands and unwittingly lay the corner stone for England's only colony in South America—the present-day British Guiana?

That in olden times the Guianas were not without appeal as a field for colonization is evident from the councils of the Pilgrim Fathers, who considered the tropical luxuriance of these parts before they decided to exert their mighty influence upon New England

shores. Still more memorable was the virtual exchange, after the Dutch war, of Guiana, or "Surinam," for what is now New York, under the terms of the Peace of Breda in 1667.

Later the sober-minded, laborious Dutch by skilful efforts succeeded in transforming much of the coastal strip of Demerara into rich plantations, relying upon the fertility of the alluvial soil, in some parts now known to be more than 1400 feet thick. After more than a hundred years of continuous subjection to the soil-impoverishing culture of sugar cane, and without stimulation of productivity through the use of fertilizer, the land still gives bountiful returns.

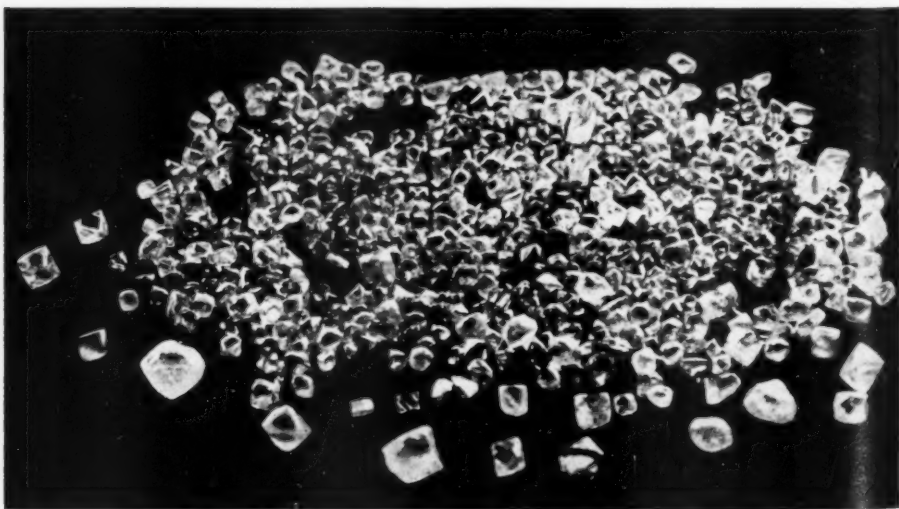
With the temporary collapse of the sugar industry after the World War and the incidental release of labor, those who were sufficiently energetic and enterprising tried their luck in the diamond fields of the interior. The results have been astonishing and a

¹Illustrations, with the exception mentioned, from photographs by the author.



A typical diamond mine.—Sand piles and water holes surrounded by a chaos of tree trunks and boulders in the midst of virgin forest are the distinguishing characteristics of the diamond mines of British Guiana. A fee of a few dollars paid to the government gives the prospector the right to stake out his placer claim of 800 by 1400 feet. Removing only three feet or so of overburden may uncover the loose, diamantiferous gravel, which is washed in the "tom," a rough wooden box having an iron screen with half-inch holes at the front of it. Through them the smaller particles are passed and hand-sieved. What remains in the sieve is carefully looked over for the precious stones.

There are no iron fences, guarded compounds, or burglar-proof safes as in South Africa. The entire police force consists of half a dozen negroes, in a region where about 4000 miners in 1922 dug out more than \$4,000,000 worth of diamonds in the rough, valued at \$25 a carat. No machinery, laboratories, or hospitals are provided, and everyone lives peacefully in temporary shelters. Trading companies supply the miners with salt pork, beef, fish, rice, beans, biscuits, and other goods, most of them paid for in diamonds, which in general the companies also purchase.



Fifty thousand dollars' worth of British Guiana diamonds, in the rough.—This harvest was gathered by a crowd of fortune hunters of every description,—most of them negroes and mulattoes, some Chinese and Hindus, and a few whites. With unflinching hope and under the most trying conditions, these miners, generally called "tributors" or "pork-knockers," have struggled, toiled, and suffered hunger in order to add their part to this glittering pile. Some of these rough stones are of the "first water," without flaw or tint. Once lifted from the loam and rendered doubly attractive by cutting and setting, they become the most cherished of treasures. The largest stone pictured weighs sixteen carats; single stones of as much as forty-eight carats have been unearthed along the Upper Mazaruni River.



Photograph by Wm. J. La Varre, Jr.

Makreba Falls, the head of navigation on the Kurupung River.—Between the rocky walls of forest-clad mountains that rise abruptly several hundred feet above the water are these falls, opposing farther advance by boat. From here famous Mt. Roraima can be reached within ten days. The route proceeds overland for some distance, with Indian "droghers" carrying the loads, and then by water in native "woodskins," or small boats made of the bark of trees, each accommodating eight or ten men. During the first few weeks of the stay, Mr. La Varre and the writer, who is shown in the above picture, made a preliminary reconnaissance and were fortunate in meeting many of the Indians who later joined the party at Kamakusa.



Rapids below Kaburi Rock.—The gallant little craft "Kamakusa," in which the author journeyed, passed most of the rapids under its own power. Only a few times did this staunch "rift-climber" have to be taken in tow. Every year the Mazaruni River exacts its heavy toll in boats and men. Only strongly built canoes, not more than forty feet in length and manned by experienced captains and bowmen, are allowed to engage in the traffic. The ever-changing water level, depending on the season's rainfall, and an essentially rocky bed are the main hazards. Every crew has its expert swimmers who, going in advance, drag the ropes with which the boats are guided and pulled across the rocks whenever the drudgery of portage can thus be avoided.

credit to the adaptability of the negro population, which outnumbers all other races among the miners. It is true that extravagant hopes of fortunes easily made and many dismal failures are a part of the story, but native improvisation is happily linked with a ready desire to share good fortune with others and at any time to extend cordial assistance to those in need. From 1919 on, the production of diamonds jumped in three years from \$478,555 (16,706 carats in 1919) to \$4,126,425 (163,640 carats in 1922). As it happened, I was making the trip up the Mazaruni River¹ at the height of this great rush, when dozens of boats were on their way to the diamond fields in the interior.

One of the most surprising facts about diamond mining in British Guiana is its extreme simplicity of operation, with an equal chance for all. Ax, pick, shovel, a miner's pan, tom-iron, pail, and sieve are the only implements used to bring the precious stones to light. After the miner has successfully probed, by means of a tough sapling, the water-soaked ground to locate the harder layer of diamond-bearing gravel, the digging commences, continuing until the promising level a few feet below is reached. There is great expectancy as the first sample of ore or "pay dirt" is tested. There may be merely what the miners call "indications," pieces of tourmaline, crystals of quartz, and pebbles of various heavy minerals, also traces of gold. Should there be a diamond, however tiny, in the first pan, it is an encouragement for the "crew," as small parties working together are generally called.

Not many months thereafter the deserted square or oblong, water-filled holes in the ground, surrounded

with embankments of soil, sand, and gravel, attest to the success achieved. The lucky miners stay at their task only a few months before returning to the coast and Georgetown. They usually escape fever, dysentery, and the host of other illnesses brought about by the extraordinary hardships, especially that of working hip-deep in water for an extended period. The journeying back and forth involves but little expense to the individual miner, who works his way up river by paddling boats engaged in transporting traders' merchandise, and for whom the homeward passage is usually free.

British Guiana's fame is linked with its great rivers: they are its network of communication in the interior. In former times no one but the daring and fearless would brave the thousands of swift channels, pilot between the hidden rocks, and cross the dangerous whirlpools. These pioneers needed courage and dexterity to ascend the torrential rapids and overcome the steeper falls. Even now considerable skill is required. After a few months of the monotony of the mining fields, however, one welcomes the excitement of river travel. There, at least, is the dare-devil joy of trusting to luck more than to experience. The return run is made with the hurrying floods and across swirling rapids in as many exciting hours as it took dreary days of toil to fight one's way upstream against the strong currents.

Along the rivers the solid walls of luxuriant vegetation are silent witnesses to the constant struggle of practically every leaf to reach the sunlight. In this spectacular mosaic flowers are richly scattered, decorating the green curtain like delicate embroideries. Tints of yellow and shades of blue in October are the prevalent colors,

¹A preliminary Note, together with a map of the itinerary, appeared in *NATURAL HISTORY* for July-August, 1923, pp. 409-11.

bright red and white being scarcer. Tall palms are rare along the Mazaruni River, and even the slender manicole seldom waves its glittering fronds. In the foreground are floating grasses and stockades of giant arums, a maze of sedges and palms climbing upward over their more powerful neighbors.

Every day before nightfall we made fast to one of the few high places along the banks out of reach of sudden floods. Tarpaulins and hammocks were the only equipment needed for passing the night. Following the first roars of the howler monkeys at the coming of daylight, fires were kindled in preparation for breakfast. A bustling half hour saw our fifty men and their belongings ready to start again. Soon the busy purr of the boat's engine and the rhythmic stroke of paddles broke the quiet, continuing until noon, when a stop was made for luncheon.

As we landed and passed through the dense curtain of verdure, the mighty tree trunks loomed up like majestic colonnades. Innumerable leaves of all sizes and shapes, impenetrable thickets, and other objects limited the range of our vision. Glimmering shafts of light set off the graceful contours of the rows of saplings and tangles of bush ropes. In the diffused soft light fantastic flashes playfully danced upon the leaf-strewn ground. Clumps of white, orange, or brown fungi, flowers that had fallen from the trees above, and a scattering of dead leaves furnished delicate touches of color among the few plants that strove in vain to escape from the gloom and decay of the forest floor. The moisture-laden atmosphere and constant heat were overpowering. Yet the infinite beauty and matchless grandeur of the scene were impres-

sive even though the minute details of so magnificent a tapestry were confusing.

Ever since I had returned from the Belgian Congo, where I had spent the years 1909-15 studying conditions in the West African rain forest, it had been my desire to see comparable South American forests. The opportunity, extended to me by Mr. William J. LaVarre, of visiting those of British Guiana was, therefore, most welcome. Furthermore, I was favored with an introduction from President Henry Fairfield Osborn, of the American Museum, to his Excellency, Sir Wilfred Collet, governor of British Guiana. From Director F. A. Lucas of the



This young male howler monkey (*Alouatta seniculus macconnelli*) was photographed at Kamakusa in December. Most young monkeys in South America are not inclined to manifest the frolicking gayety or to indulge in the capricious and fantastic tricks that characterize the behavior of Old World monkeys of corresponding age and size. Their actions remind one rather of the slow, serious, well-seasoned manners of old people. Shortly after being taken these howlers refrain even from biting and become affectionate pets. But they should never be made captives as it is almost impossible to keep these leaf-eating primates in good health.

The adults are the strongest and most heavily set monkeys of the New World and evidently for this reason have been dubbed in British Guiana "baboons," a term which the negroes have brought over from Africa, where it is applied correctly to a large powerful ape of chiefly terrestrial habits. Troops of these reddish-brown howlers are especially famous for their vociferous sunrise serenades. Energetic in this performance, they show less virility in climbing about in their high leafy homes, seldom moving in great haste although they are by nature nimble-footed and are assisted by a prehensile tail.



TREE FERNS ALONG THE TACOPA RIVER IN NOVEMBER

The gently drooping fronds of tree ferns are a strikingly pleasing feature in any landscape. The harmonious beauty of this shimmering grove, placed in an otherwise dismal swamp, sharply contrasts with the riotous variety of forms in the adjoining forest. Yet these graceful masses of foliage with their slender, fues-covered, brown stems, constituted a most forbidding thicket. Sharp, recurved thorns along the base of the leaves warned against approach.

American Museum I received other valued privileges. At Kartabo, Mr. W. Beebe, director of the Tropical Research Station of the New York Zoological Society, extended his hospitality.

The more important ecological differences between the two regions are striking in their essential features. In both countries the temperature throughout the year is about the same, 85° Fahrenheit, with but slight changes day or night. The average annual rainfall also differs little, being always more than sixty inches, and the dry season lasting less than three months. In the formation of these forests, however, the relative amounts of rain and sunshine, humidity and heat, are significant factors.

In South America the generally more inundated condition of the ground is as marked as are the greater variety of plants and the denser and more united forest canopies. The larger number of palms and especially the conspicuous display of luxuriant epiphytic plants, such as bromelias, aroids, peperomias, orchids, ferns, and mosses have no equal in Africa, where the larger air plants—*Platycerium*, *Asplenium*, and other ferns that attach themselves to trees—are more widely scattered, and orchids are inconspicuous and few and far between.

Excluding the vegetation of mountainous areas and sections along rivers, the rain-forest formations in both regions can be roughly divided into three types: (1) the higher-lying, drier forest with magnificent columnar trees, about 150 feet in height, and relatively little undergrowth; (2) the intermittently inundated forests, generally considerably lower, with a more impenetrable and diversified flora, containing numberless climbers and air plants; and (3) the secondary forests

on ground once cleared by man. Here there are a few predominant types. In South America the groves of "Congo pump" (*Cecropia*) and the "bastard plantain" (*Heliconia*) play the rôle assumed in Africa by the "umbrella tree" (*Musanga*) and what remains of plantains and bananas formerly under cultivation; and many large-leaved marantaceous and gramineous plants are common to both.

In equatorial West Africa, at least in the northeastern section of the Belgian Congo, where I spent several years, the rain generally falls within a few hours, and often this occurs during the night. At any season, therefore, there is an abundance of sunshine. In this area the gigantic trees are more scattered, the crowns of many reaching above the general leafy roof and appearing, as one looks down upon them from some height, like islands rising from a green sea. Such an arrangement admits more sunlight in the lower strata of the forest and rather favors the development of rapidly moving, gregarious, diurnal forms of monkeys. With the exception of a few lemurs the African primates are chiefly diurnal. They are much less specialized than their South American relatives and show no such parallel development with other groups as is indicated by different kinds of the smaller South American "squirrel monkeys."

In British Guiana, on the other hand, the rain, during what is called the "dry" as well as during the wet season, descends in frequent showers, and the hours of sunshine are considerably reduced by a more or less continuous drizzle.

These conditions may have brought about the peculiar arrangement of the vegetation. Certainly the dense clustering of leaves toward the roof of

an otherwise diurnal swamp, sharply contrasts with the riotous variety of forms in the adjoining forest. Yet these graceful masses of foliage with their slender, fur-coveted, brown stems, constituted a most forbidding thicket. Sharp, recurved thorns along the base of the leaves warned against approach. The harmonious beauty of this shimmering grove, placed in a strikingly pleasing feature in any landscape.



LARGE-LEAVED AROIDS CLINGING TO TREE TRUNKS

Sunny exposures on tree trunks are always apt to support clusters of air plants. Marvelous is the adjustment of the long-stalked, huge leaves, all placed so as to take advantage of every bit of sunshine. Were it not for their vertical position and remarkable surface structure these immense leaves—the larger are nearly two feet in length—could not meet the torrents of rain unscathed. Accidentally one of the vertical absorbing roots has been torn from the adjoining tree trunk to which it was previously attached by small, horizontal, anchoring roots, such as are seen on the tree trunk in the center



Long, pendent clusters of purplish young leaves in a leguminous tree.—In October and the months following, patches of bright foliage—green, pink, brown, and other colors—give pleasant variety to the otherwise somber forest walls. One is naturally reminded of the riot of colors in the woods of temperate regions during the renewal and the shedding of the leaves. The exceedingly rapid growth in the tropics of these freshly emerging leaves is probably correlated with their relative limpness and their propensity to cluster. Botanists have often ventured to delve into what is evidently one of nature's protective devices. Are these peculiar assemblages of drooping, tender leaves better enabled than would be scattered individuals to escape the ravages of heavy rain showers, strong sunlight, or excessive heat?

the forest in one unbroken canopy, or wherever there are open spaces, the situation of the air plants, abundant and luxuriant mainly on the sun-exposed side of the tree, and the large size of the leaves of many of them, as well as their position, would indicate adaptation for deriving the maximum benefit during the short time that the sunlight is available.

The gloom of these forests shelters a relatively large number of nocturnal mammals. Few are swift and many of the arboreal types in the different groups have a prehensile tail. The spider-, howler-, and woolly-monkeys, porcupines, opossums, and anteaters include characteristic instances. In Africa the only mammals which have any claim to a prehensile tail are two species of scaly anteaters, and they are

really of Asiatic origin,—a region where a prehensile tail is a not uncommon appendage of mammals although less so than in Australia, where many of the marsupials are provided with such a grasping organ.

The peculiar environmental conditions in the tropical rain forests and their outliers of both Africa and South America have undoubtedly had still further influence upon the evolution, habits, and distribution of the principal types of their distinctive mammals. In West Africa the essentially greater extent of the higher-lying forests (those of the first type) allowed a variety of mammals of large size to become established. Thus we have there elephants, buffaloes, a host of antelopes, several large carnivores, and—most representative of all—the large endemic an-

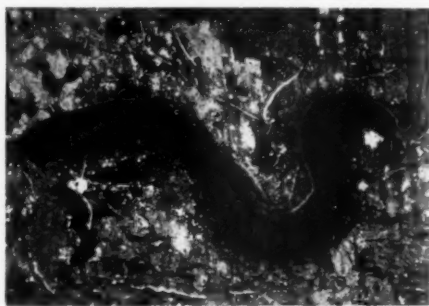


Conspicuous in the midst of their leaf-bearing neighbors are the gigantic trunks of dead trees, often more than a hundred feet in height, covered with formations resembling reddish soil. Myriads of termites, or "white ants," burrowing in the tree, have transformed the dead wood on which they feed into these structures, the numberless tips of which, reminding one of the reversed points of a coronet, drain off the rain when it descends in torrents and thus assure the tiny builders a secure abode and shelter. Every particle the insects devour serves to reinforce their home externally and to extend the immense network of galleries through the tree, until the final collapse of the trunk seals the fate of the aerial abode of these ruthless tunnelers

thropomorphic apes,—the gorilla and the chimpanzee. In South American forests the swamp-loving tapir, a few deer, and a jaguar are the largest mammals. Most other good-sized terrestrial forms are either aquatic or cursorial in adaptation, which allows their rapid escape in times of flood, when the change in water levels sometimes amounts to more than forty feet.

While in Africa the antelopes have produced through adaptive radiation a large number of different forms, in South America it is the rodents which exemplify such a development.

As a rule in the immense areas of contiguous tropical rain forests of the equatorial belt mammal and bird life appear much scarcer than along clearings and river fronts, and on the open, more diversified stretches, which help to foster the gregarious instincts of herds and flocks. In rain forests, however, the fauna is scattered over many levels, from the ground upward to as much as 150 feet in height. To the newcomer it may indeed seem that mammal life is totally absent. A white man's progress through such dense vegetation, no matter how careful, is generally heralded from afar, so that most mammals seek covert long before they can be discovered.



Peripatus is a most puzzling creature with the rare distinction of having been considered at different times a worm, a mollusk, and an insect, though, according to present belief, not far removed from the millipedes. Fond of darkness, moisture, and decay, it lives in or about hollow, crumbling pieces of wood. The dull, velvety brown, extensible body has in life a peculiar iridescent "bloom." When the creature raises the anterior portion of its body, the feelers take an active part in directing the course. Thus the *Peripatus* readily avoids obstacles and though moving slowly, assisted by the tiny, terminally clawed legs, can assume any kind of position. A secretion of slime, withdrawn into the buccal cavity whenever the *Peripatus* stops, marks the glimmering trail and apparently furnishes an indication to others of its kind. Its prey—insects and spiders—may also be captured with slime that can be ejected from the oral papillæ for a distance of about six inches. Sixteen of these primitive arthropods were secured



The black puff bird (*Monasa nigra*).—These birds loved the edge of the large forest clearing that faces the river at Kamakusa, and proved to be rather confiding. Seldom were there more than three or four of them in sight at one time, and even then they would perch at considerable distances from one another. They frequently remained in the lower branches of the trees, returning to a chosen site even after chasing passing insects. In both sexes the dark, slaty-black plumage with a grayish under side is sharply set off by the bright scarlet bill. During January the short but melodious song of these birds, resembling that of the European black-bird, was by far the best vocal performance in the jungle. Furthermore, one or another of these birds was apt to gush forth its sweet whistling notes at any time from sunrise to sunset,—even at noon when the noisiest of birds preferred to remain silent. Although their song was so prevalent, Mr. Lang was surprised to find that apparently they had not been given credit for it. Only their sharp call had previously been recorded. Evidently the beginning of the year, when Mr. George K. Cherrie and Mr. Lang enjoyed the singing many times, is the courting season of these birds on the Upper Mazaruni.

In the immediate neighborhood of much-frequented watercourses mammals are naturally scarce. It was a surprise to see the leisurely moving, reddish-brown howler monkeys, and the much quicker, small sakis. A few sluggish, rough-haired, three-toed sloths, resting huddled up in the fork of a tree might have been mistaken for a termites' nest. Never were we so lucky as to see herds of peccaries, a tapir, or a

puma crossing the path of our boats, though later when on land we were more fortunate.

Time and patience, however, stood me in good stead. My efforts to secure comprehensive information about different groups of animals and about the forests were successful beyond my fondest hopes. I was also able to



These six tiny bats (*Rhynchiscus naso*) clinging to a snag were photographed near Kamakusa. On the Mazaruni, as on other rivers of tropical South America, several kinds of small bats rest exposed to daylight on the larger branches or roots projecting above the water near the banks. Though dark in color, they were not readily detectable until they fluttered up, disturbed by the approach of our boat. Some would shift to the opposite side of their perch, as they habitually do when bothered by the sun. This manner of roosting is peculiar to these small insectivorous bats of the Neotropical region. Such an unusual trait may be due to the abundance of bees and other hymenopterous insects that in South America preempt the available hollow trees and cavities which in other countries serve as the headquarters of bats of this type. In other respects these bats are as nocturnal as their close relatives in Africa, Eurasia, and Australasia, all of which seek retreat in dark or at least well-shaded places, although members of the family Megadermidae are sometimes about during the day. At dusk they certainly prey upon the untold numbers of minute nocturnal insects on the great flowing highways. These bats have a body length of about one and a half inches.

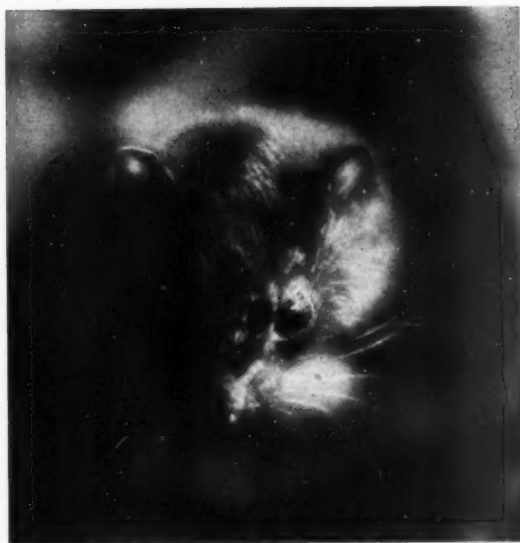
enrich the collections of the American Museum in many different branches through the presentation of mammals, birds, turtles, snakes, frogs, fish, butterflies, ants and many other insects, as well as lower invertebrates, not to mention plants and a series of photographs and moving pictures. Some of

the creatures proved new to science but all were most welcome, for from that part of the Guianas hardly anything had reached the Museum previously. What to some has been an awe-inspiring, fearful wilderness, to me was a magnificent playground. For months I was repeatedly thrilled with joy.



A female tree frog *Hyla evansi* with a cluster of twenty-four eggs on her back.—The future frogs, visible in some of the jelly-like spheres, are still in the stage of tailed larvæ with rudimentary limbs. According to Dr. G. K. Noble, they have a primitive type of air-breathing gill, to be described in a scientific paper that is in course of preparation. The eggs adhere to the frog's finely granulated skin by means of their gelatinous coverings that in the case of the outer ones form a narrow rim around the egg mass. The eggs are the size of a large pea, about one-quarter of an inch in diameter, and the body length of the frog is about three inches.

The frog was found at Kamakusa toward the end of January, sitting in the gloom of her self-chosen moist retreat, a large decaying tree trunk open on one side. Here she was probably able to feed upon the numerous insects always infesting such sites. Far from being hampered by her load of eggs, she could clear several feet at a jump without dislodging her burden. This species was previously known only from a single specimen in the British Museum.



Photographed and copyrighted by H. H. Heller

Cholita, a little bigger than life size

Peruvian Pets

By HILDA HEMPL HELLER

FOREWORD.—Mr. and Mrs. Edmund Heller journeyed to the interior of Peru to collect specimens of mammals for the Field Museum of Natural History. Their route lay from Callao and Lima to Cerro de Pasco by rail, over the Andes, and down the Amazon. Several months were spent at different altitudes in the valley of the Huallaga River. The first collections were made at La Quinua and Chiquerin, a little below timber line at an altitude of about 12,000 feet. Ambo, a small town at the junction of the Yanahuanca River with the Huallaga, was then taken as a base. It is about 8000 feet in altitude and the climate is dry, not unlike that of southern California. Later followed a three months' expedition to the wet tropical valleys of the Chinchao and Cayumba rivers (2000–3000 feet) and to the flat plain below at Tingo Maria on the Huallaga. Collections were then dispatched from Ambo, and the expedition emerged from the valley of the Huallaga by way of the high Cordillera to the east. Pozuzo, at an altitude of 2000 feet in a rich tropical valley, was an excellent collecting site for a month. Then navigable water was sought at Puerto Mayro on the Palcazu, a raft was made, and the expedition fared down stream to Puerto Victoria on the Pachitea River, where additional collections were made. From Puerto Victoria down the Pachitea and Ucayali rivers to Iquitos on the Amazon, was a voyage of a week on a barge towed by the mail launch. Thence a two-weeks' voyage down the greatest of streams to Pará brought the travelers to the Atlantic Ocean.

IT is a very sad fact that if one is so devoted to animals that he renounces the world for the sake of studying them, he eventually finds himself in the unhappy position of killing the very things he loves. And though he kills for the sake of the science that is eager to know the shapes and sizes and colors of the wild things of remote districts,

he ponders over the bodies of the beasts as he skins them by the lantern light, wondering how they lived and hunted, how they fed and loved, and how they reared their babies, and he wishes they were alive again. Always through his mind the thought runs, "We might have been friends, you and I, if things had been different.

The museum will be glad to get such a rare specimen as you, but what will it know of the real you from your skin and skull?"

My husband and I were two that loved animals. We hunted in the high bare mountains, in the wet steep forests of the eastern Andes, in the flat Amazonian plain. But the animals that came to us in sound condition, most of them by purchase, we kept alive, and made members of our household, giving them every comfort in our power and spending such spare moments as we could in observing their behavior and in photographing them. It was a rich experience.

CHOLITA

The houses of the Indians in the dry portion of the Huallaga Valley are solid mud structures with few chinks for the passage of small animals. Their kitchens are the dwelling places of innumerable guinea pigs. Under the



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Cholita playing.—She would put her little forepaw on her string to balance herself

doorsill or by the sash at night enter small yellow-bellied weasels to feast on the helpless rodents within. Sometimes a mother weasel is followed by a baby two or three inches long. The people love to catch these baby weasels; they tie a cord about their neck and tame them very easily. If taken young enough, it is said, the weasels will remain with their captors free of any restraint, but Cholita, who was caught half-grown by Old Basan of the neighboring village, was freed only when the room was carefully closed. Young Basan sold her to us. She was a beautiful creature. At first my heart did not warm to her, for she escaped from a close-barred parrot cage and very shortly buried her teeth in the scalp of Maria Louisa, one of our opossums. After that we kept her tied. She lived in a wool sock, turned double for warmth, and spent much of her time in sleep. Every morning we had breakfast at my bedside and Cholita's leash was transferred to a rod of the bed. Fried egg, placed on the edge of my plate, was her breakfast, and always she seized it and dragged it away.

After breakfast she played. To see her play but once was to love her. Sometimes she reminded one of a kitten, and was always lithe and graceful with a marvelous command of every movement. She had a pattering gallop about the counterpane, following a hand with incredible rapidity, or turned on her back and clawed and bit a finger gently, always very gently. With the whisking of a handkerchief she became madly active, transporting herself from point to point of its swing with almost invisible flashes of her brown body. Her joy in life was infectious; it made one long to be a weasel and to use one's muscles with her exquisite precision and grace.

The day came when we had to take a long journey on mule back, and Cholita was chosen to accompany us. She traveled in a canvas game bag that contained her sock, and was slung on my back. At night she reposed in my sleeping bag, nose-to-tail in a ring of the proportions of a doughnut, and lay between my knees and chest as I was curled up in the army blankets. Sometimes, waking, I feared I had crushed her in turning while asleep. Then I would pick her up to see how she was. Always I had to manipulate her limp body for some seconds before I could find a sign of life. Such a sleeper! She never went to sleep in the open, apparently for good reason.

We found that one of Cholita's habits, perfectly harmless in the uplands, was very inconvenient in the montaña. She always dragged some portion of her meat into her sock with her in order to keep it for further feasting. Here in the tropics the ants soon found it and we were obliged always to remove all traces of meat when she was through eating. It was funny to see her attack food that was covered with ants. She would make a grab, shake the meat and drop it in a clean place, then shake it again till it was free. When the ants bit her hind feet, she stamped the floor rabbit-wise with both feet repeatedly.

Cholita did not defend her food from us. Neither did she thank us for it. She beheld it, grabbed it, almost saying, "That's mine," and ate ravenously. If we took it away, she made no threat. One day, however, I had a surprise. Her cord, as usual, was pinned to my blouse—I wore her much as one does a watch. In my left hand I held a tiny opossum; on my right, at the end of her leash, was Cholita, straining to reach her game. But this

was not to be her game, and I took the opossum away. However, her mechanism of attack had been sprung, and she assailed blindly, not the opossum, but me. Her tiny mouth grabbed fully a chunk of skin on my wrist and then she started to kill that wrist. From side to side she wrenched her head and shoulders violently and with force incredible for a thing so small. For several seconds this continued till she came to her senses, let go, and "was friends" again. Her short teeth almost went through the skin, and points of blood appeared. I believed she had suffered a brain storm and did not punish her.

On another occasion, however, I tried to see if she could be trained at all. I wanted to have her with me, and was at work stuffing mouse skins. On the table lay a tiny skin well rubbed with arsenic and rolled tight. This she seized. I took it away and gently snapped her nose. She grabbed it two or three times more, each time receiving a snap, and once she threatened mildly by opening her mouth as a cat does. Then she let the skin alone and I had no more trouble.

We were always afraid diminutive Cholita might meet her end by some animal's attack, or by being stepped on. But we should have looked out for smaller enemies. The wet montaña was not her country, for she was a child of the desert. She abandoned her sock one day for a tunnel at the base of a stump. "How nice!" I thought, "Just the way weasels like to live." And I let her enter her hole and stay there for a time. The next day came a mad voyage down turbulent rapids in a ponderous dugout. Time and again we shipped water. My blouse was soaked; Cholita, inside my clothing, was none too dry. The following morning my husband saw her lying

on the earth outside of her sock and began a loud lament. She was unable to move and he thought she had been stepped on. I felt the little body but nothing was crushed. She was breathing very fast. Pneumonia! I put her in my blouse and in five minutes she was dead. Two very sad people worked silently and tearfully at the skinning that day.

RUGUPI¹

One of the first obstacles the traveling naturalist must overcome is that of vocabulary. Each valley has some animal names different from those of the next and each has some creatures distinct from those in the last. The people one encounters know some of the animals by sight and some by description. Occasionally these descriptions are very weird, for one may hear of a beast combining many of the attributes of a bush-running rodent and a tree-climbing carnivore. The naturalist must inquire constantly, weigh hearsay evidence carefully, and hunt for material evidence unceasingly.

Late in the afternoon of a perfect day of wandering we arrived at San Antonio, one of a string of coca *haciendas* owned by Don Augusto Durand. With the gentlemen of the *hacienda* we had a spirited conversation concerning the animal population of the valley. Suddenly the *administrador* of the *hacienda* turned to his companion, saying, "Shall we show them the animal?" And he sent for it.

It was a beast such as I had never dreamed of. About ten inches long, disproportionately wide and corpulent, with a massive rodent head, a curious chopped-off chunky tail, gray extremities, and a blackish-brown coat longi-

tudinally striped with tan spots. Its manner attracted more attention than its shape. It was angry, and made a noise of great protest, more like that of a fox squirrel scolding a cat than anything else. It was set before us by the cook, a plump Indian girl. It objected to being introduced, fled to the skirts of the cook, and when I tried to pet it, charged my feet abruptly.

"That is called 'rugupi,'" said the *administrador*.

"That is called by the *científicos* '*Dinomys*,'" said my husband.

A month later we were the fortunate possessors of Rugupi. The kind *administrador* presented her to us in the interest of science and of friendship. I carried her up the mountain to our camp on horseback in a gunny sack, to which she objected and in which she fought. She was hot and winded and I put her in a dark corner and wet her head. Later she scolded me furiously when I approached her but, when I sat quietly without touching her, she fell instantly asleep.

Rugupi was a great prize and we guarded her carefully. First on the list of mammals desired by the museum was the *Dinomys*. For nigh fifty years the unique family of rodents to which it belongs was known by one solitary skin in the museum at Warsaw. Then there appeared at the Zoological Gardens in Pará two strange creatures that were greeted with great interest by the director, Doctor Goeldi. Frantically he searched his texts. "At last," he wrote, "I realized that I had before me the almost mythical *Dinomys branicki*." When an animal that until recently was "almost mythical" comes to eat with you, sleep with you, and travel with you, you start walking on air right away. I passed Cholita to my husband's cot, Rugupi slept on

¹The word is spelled "rucupi" by the Peruvians, but the "c" is slightly voiced, and the spelling "rugupi" better expresses their pronunciation.

mine. We observed here every movement and spoiled her as one spoils only that which is given him by divine favor. We became obsessed with our research into the habits of rugupis in general and of our Rugupi in particular.

Rugupis are dwellers in cliffs of the wet forest country. They are Andean only, and cross to the western slope of the Cordillera solely in Ecuador, where

ponderous body and always sought to remain on the firm earth.

Rugupis live in caves and rock piles, and want walls behind them. Once we camped by a cliff with caves in it and Rugupi deserted my couch for a cavity into which she fitted better than a snail fits its shell. She always loved the seclusion of a cupboard and if she ever saw one open, she observed which way



Photographed and copyrighted by Edmund Heller

Rugupi had a firm attachment for the cook, a plump Indian girl

the forests cover the western declivities. They can exist only in steep places, for to escape their enemies they must rely on their single acrobatic feat, which is to balance themselves cautiously where others cannot climb. Even when well grown, Rugupi's fastest pace was slower than our walk. Usually one could observe that whenever Rugupi placed a foot, she felt of the ground first before bringing her weight to bear. It irritated her terribly to be lifted or carried. She had little control over her

its door swung and later gnawed the outside of the cupboard doors by the latch in order to open them, and did not gnaw near the hinges. In many other ways she showed a marvelous memory for location.

When we met Rugupi, she had a firm attachment for the cook which she was later able to transfer to me. She slept all day, but lightly. Although we left her apparently dormant in a remote corner, she soon started to gnaw the inside of the door once we were



Photographed and copyrighted by H. H. Heller

Mr. Heller and Rugupi

outside. When I wished to extract her from her snail-shell cave, I sent the others away and remained silent near the opening. In three minutes she was out, calling, "Oop? oop?" Her fear of being alone was always apparent; she followed us in our walks, often at a rate unsuited to her short legs and shorter wind. She also loved smaller animals and was exceedingly gentle with them, which she was not with us.

Because they cannot run, the rugupis are intensely cantankerous and belligerent. Their signal of defiance is a loud sudden blast of air through the nose, sounding exactly like that of a bear. They wheel and charge on very slight provocation, but try to keep a wall at their backs. Rugupi's milder slashes, made in pettish moments, were like knife cuts and produced many scars, for her teeth were as sharp as broken glass. Once, in the night, I felt the full force of her angry bite. We were in a colder country than hers, and I wished to cover her when she crawled from her usual station at my feet up beside me. She did not understand and bit my thigh with all her power.

She was then less than half grown. Luckily there were two blankets to protect me and the teeth did not cut through them. The pain was intense and the black and blue spot that followed was very long-lived.

Another local name for rugupis is *carron*, and yet another is *machetero*. The latter refers to their habit of clearing their trails of branches; they trim away all the twigs and their trails may thus be distinguished from those of pacas. With us Rugupi had no trails to clear. So her cutting energy was diverted to whatever else she could reach. There was not a piece of furniture or harness, a boot or camera case or reachable trinket that did not show nicks or slashes or holes. Even the mud walls of our room suffered.

At table, if we gave her a plate with various vegetables, fruit, bread, and meat, she always ate the meat first, and was impartially devoted to the



Photographed and copyrighted by Edmund Heller

Mrs. Heller and Rugupi, whose glossy second coat is appearing

other foods. I shall not venture to state how much she ate, as no one would believe me. In camp she wandered at will and preferred shrubs and the roots that she dug to grass. In the evening after a long day of travel she would go out in the brush and feed. At intervals of about three seconds she uttered a cozy little musical call that may be transcribed, "Oop?" and if we called to her, she invariably answered, "Oop." When we retired and the light was out, she promptly re-entered the tent and, if we slept on the ground, took her station for the night in a sitting posture between our heads, or, if I were on a cot, she slept under my head.

Most remarkable was her use of her tail, feet, and hands. She was almost as much of a tripod as is a dinosaur or a kangaroo. The tail was an indispensable part of her sitting equipment. I make no claim that it was prehensile, but she used it often in negotiating difficult places around rocks and would push with it, and to some extent balance with it, and even hook it on to rock edges for an instant. We found it exceedingly useful as a handle, and often remarked that Rugupi probably wished she were a paca. She was super-plantigrade. Her hind feet were like rockers, she did not place the whole foot on the ground at once when walking, but used the front two-thirds of it. But if she stood on her hind legs and tail to reach, the higher she stretched, the higher her toes went into the air. All food except the veriest liquids she took into her hands. She made an awful mess of soup which she regarded as a solid. She usually picked up food in her mouth and then seized it with one hand if it were small, or sat up and grasped it in both hands if it were large. She was thumbless, but what

would have been the ball of her thumb if there had been a thumb served very well instead.

I carried Rugupi five days on my back over the most difficult trails imaginable to Tingo Maria, and four days on the return journey over the same trail, and then on muleback to Ambo. When we started on the next expedition to the far-off Amazon, she was too big for me and we hired a man, then a horse, and later another man to bear her, and she was somewhat expensive as the journey was long. But she was worth it, and anyway we loved her and do yet. She is now in Lincoln Park Zoo in Chicago; her coat is sleek gray and black with white spots; she sleeps all day; and, sad to say, has no furniture or leather goods, toothbrushes or pencils to investigate at night.

TIMMIE

Timmie was a *zorro de las alturas*. *Zorro* means fox, and Timmie was much like a fox in appearance. His closest relatives, however, are the wolves, not the foxes, though his scientific name is not *Canis* but *Pseudalopex*. We called him a wolf.

Timmie came to us in the arms of the sturdy son of our former *arriero*, or muleteer, Maïs. The home of Maïs was high on the mountain above Ambo, perhaps at 11,000 feet. The family of Maïs had had Timmie for two weeks and the animal was well-nigh starved. Timmie's twin sister had died from lack of food. In addition to being famished, Timmie was covered with fleas and very dirty. I filled a large photograph tray with water, put on a rubber apron, sat down in a good light with Timmie and a box of pyrethrum powder, and did murder on innumerable fleas. Then I went to the sole practitioner of medicine in the village,

a Japanese, and bought santonin of him, which I administered. After he had been a few days on a diet of milk and fresh birds there was a marvelous change in Timmie. From a shadowy bedraggled wisp of life he became a



Photographed and copyrighted by Edmund Heller
The son of our *arriero* brought us a starved wisp of life which he called a *zorro*

dainty brisk little wild thing that played about the room whenever he thought he was unobserved.

The keynote of Timmie's character was fear. His name Timmie was derived from *timido*, not *Timoteo*. He was an adept at hiding, and to win his confidence was a labor that I did not understand as well as my husband did. I was, for one thing, too interested in keeping Timmie clean. He did not want to be clean, he had not the remotest aspirations that way, and to clean him I had to handle him and comb him, and he did not want to be handled.

Moreover, I made the mistake of supposing that he could be mildly chastised for biting, and early set about training him not to bite. It didn't work. Timmie was not a dog. His sole reaction to my caresses was to bite me; and to my slaps, to hate me. My husband started to handle him with gloves when he was ridiculously small. I laughed at him but he was right. Timmie bit him frequently, both in play and in fear, but as they grew better acquainted, there was more play and less fear; later Timmie grew to love and trust my husband and became a veritable one-man dog to him, but my husband never abandoned the gloves.

Only when we first had him, did Timmie utter any kind of call: a high-pitched clear succession of descending notes, only a few, that stirred the heart with memories of Wyoming hills. It resembled the opening notes of a coyote's call, but was high and faint.

When Timmie was first brought into the room, Rugupi beheld him from a considerable distance. "Woooo, woooo, woooo," she called, low and affectionately. We placed him before her and she buried her teeth in his wool caressingly. From that moment she appropriated him. She deserted my couch and slept with Timmie. She was infinitely patient with him and his nips at her heels spurred her on into playful lumbering gallops about the room. Rugupi was not built for gallops; invariably they ended in her colliding with some obstacle. Rugupi always defended her food from us. One morning at breakfast she was presented with a piece of bread, the first bite she had had since the day before. She rose on her hind legs, deliberately adjusted her balanced

sitting posture, and bit into the bread. Timmie darted alongside, grabbed her breakfast, and made off with it. She accepted this as demurely as though it had been a favor.

Later we acquired another small wolf, that lived with Timmie. We journeyed to Huánuco to find transport for our next expedition. We lived in a windowless room that had not even a pane in the door. It was on the ground floor of the *patio* where everyone passed. We called it our *cueva de moscas*, or fly cave. Oh, the misery of that room! The two little wolves were, mildly speaking, dirty nuisances. The dainty opossums, immaculate Cholita, prudent clean Rugupi,—it was only a pleasure to live with *them*. We kept a trunk before the door to keep the wolves in. Their scissor-like teeth tore holes in my beautiful new highland wool blankets. They mauled each other all night. I would put Rugupi on my bed to save her from their too boisterous play, but she would walk the edge of the bed awhile and then jump down. One night Timmie killed the other wolf. He meant well, but didn't express himself tactfully enough. The next morning he disappeared, possibly in search of his missing companion. My husband walked the courts disconsolately seeking his beloved pet. I must tell no one he was lost, as *zorros* are very famous chicken thieves, and the place swarmed with chickens. In the afternoon my husband fell asleep. When he awoke, Timmie was beside him.

There was a boy from Llata that served our meals. One night he said, "That *zorro* will be very useful to you."

That Timmie could ever be of any use had not occurred to my most active imagination. "How?" I asked.

"When you travel, he will bring you chickens," he answered. "We raise



Photographed and copyrighted by Edmund Heller

Rugupi appropriated Timmie for her own



Photographed and copyrighted by Edmund Heller

Timmie, the *Pseudalopex*, in his woolly infancy



Photographed and copyrighted by H. H. Heller

Timmie was long in losing his bluish wool and changing to a reddish wolfling

them for that. When you travel, you let the *zorro* free at night, and in the morning there will be a row of chickens by your bed, six, eight, ten."

"But how about your own chickens, at your village where you raise *zorros*?"

"Oh, one must have a permit from the sub-prefect," he answered, "And

the schoolhouse opposite. My husband's ingenuity was taxed to the utmost to devise ways to keep him tied. His scissor-like teeth cut every rope, his lunges broke every available chain. He was a watchdog of the first order, growling and snarling at all passers-by. But to my husband he would come



Photographed and copyrighted by H. H. Heller

Timmie grew to be a fine little one-man dog to Mr. Heller

swear never to let them go free there. But when one travels, that is different." Oh, Peru, Peru, Peru!

In Pozuzo it was warm and Timmie grew fast and lost his downy gray wool and became a reddish-yellow, coyote-like beast. I loved Timmie, but he was such a trial! I banished him from our living quarters and he was tied near

trotting to be petted. If he got loose, he hid till my husband called him, and did not molest any chickens.

We traveled six days afoot to the Palcazu, Timmie in a box tied above that of Rugupi, and later reached the Pachitea. We had no cage for Timmie and he was tied in a launch towed on the right side of the mail launch, while

we were in a barge on the left. One night as I slept a live mass of wriggling small wolf jumped on my ribs, then on my husband's ribs, and then on our boy's ribs,—leap, leap, leap from bed to bed. "Timmie's loose, tie him up," I woke my husband. But the knots he made were useless. Timmie cut them, and in the morning was gone, into the mighty Ucayali probably, and we were sad again.

SEÑOR HUAMÁSHU

When Cholita died, we missed her very much. On the trail from Tingo Maria as we stopped to rest and take Rugupi from her bag to let her walk about, my husband would say, "When we rested here before, I had Cholita, and let her run around on that log." We wanted another weasel if we could find one.

In the valley of the Chinchao we bought a couple of skins and skulls of a giant relative of Cholita's, black, with a gray-brown head, short legs, and a long tail. This animal was called by the natives *huamatáru* or *huamáshu*. The two names were usually given, both in the valley of the Chinchao and that of the Pozuzo. From the skins and meager textbook descriptions we made out that this animal must be the *tayra*, or *Galictis*.

There was a fascination about the black musteline skins from the Chinchao, and gradually my wish for another weasel transformed itself into a still stronger desire for a *tayra*. What would one be like: would it be gentle and playful like Cholita, and might we be friends with it?

We started on our second expedition for the montaña and one day reached a high valley of the puna, at 10,000 feet, and stopped at the pastoral village of Chaglla. There we were met by our contractor of *arrieros*, Don Antonio.

"There is an animal here, let us see if the Señora knows what it is." Questions were useless; he only repeated, "See if you know what it is," and led us to a mud hut. There on the floor was a small black animal, running free but with a string tied to his neck and, as he ran, he muttered, "Up-bup-bup, bup-bup-bup, bup-bup-bup."



Photographed and copyrighted by Edmund Heller

Rugupi and Timmie were carried by a coca-soaked *cargador* on the journey to Pozuzo

Delight filled my heart. Did I know? "A *huamáshu*! A *huamáshu*!" I seized him and showered him with caresses. I kept him with me and made too great display of my joy. Niséfero, his owner, lent him to me for two days and then asked three pounds as his price. I beat him down to one and a half pounds, and paid for my treasure.

"*Mejor pagar primero, cariñar después*," (Better pay first, show your affection afterwards) was the pat remark of Don Antonio.



Photographed and copyrighted by H. H. Heller

WHAT NEXT?

There is no happier-natured creature than a tayra unless it be a baby tayra

I passed Rugupi to my husband's care and took the baby creature for my own. The little tayra's home had been in the high forests over the great divide that lay before us at an altitude of about 8000 feet. Niséfero's brother had shot the mother, and on her back, a little before the tail, found a tiny baby, blind and helpless except for the fact that it was able to cling tightly to the mother's hair. The man was bound for the highlands, a long journey, but he kept the baby warm and, when he arrived in Chaglla, it was still alive. Niséfero had a large bitch with puppies; he killed the latter and gave the mother the tiny black stranger, who, blind though he was, had not the slightest doubt as to what course to pursue. When we arrived, he had just been weaned because his teeth

were injuring his foster mother, and he was on a diet of crackers and coffee.

Soon we learned what an appetite, a hearty genuine appetite for food, was like. Never did a creature defend his property so savagely and blindly from all comers as did little Huamashu. A dish of crackers was set down; he pounced on it and began gobbling furiously but, as he gobbled, there was a constant accompaniment of coughlike sputtering sounds—one could hardly call them growls—and if a hand approached him, it was immediately seized and bitten with a tenacious mangling bite.

At other times our new pet was the most amiable, jolly, affectionate, and lovable creature it has ever been our pleasure to know. He would not be a musteline if he were not playful, and he

played all the time that he was not engaged in sleeping. Like Cholita, he slept very soundly, and it took seconds to wake him, but unlike her he slept curled up in the open and only sought cover for warmth. His play consisted in climbing wherever he could climb to; he was able to proceed slothwise upside down as well as right side up, and to do so much faster than a sloth. A hand he always seized in all four feet and mouthed, closing his teeth on it, biting it and shaking it, always gently. Toys were a great delight to him, and once, when he had embraced a roll of paper and was clawing and biting it, I started to remove his plaything and that strange frenzy of defense of property took possession of him; he gave my thumb a terrible punishing.

The mustelids, which include the weasel, mink, fisher, martin, skunk, wolverine, and otter, respond to the presence of a possible victim by a blind furious attack, during which they are electrified by an all-compelling power, and perform unbelievable muscular feats. So strong is this instinct that it often lures them to their own destruction. They frequently attack creatures larger than themselves and can endure a terrific amount of battering. It was impossible for us to punish Huamashu. Any slaps we felt cruel enough to inflict were taken cheerfully as part of the game and had no disciplinary effect whatever. One night Huamashu was tied to a balcony on the third floor of the high-ceilinged hotel in Iquitos. A thunderstorm frightened him and he leaped. His head slipped the collar and he fell to the ground. The next day I found him in a shop more than half way around the block (he would not cross streets) and his only hurt gave him a slight limp.

Although many of his relatives are strictly carnivorous, our new friend was anything but that. The tayras are known as chicken thieves, but are also famous fruit eaters. Along with their omnivorous habit goes a marked social one; there is food available for families traveling together. An elderly woman of Pozuzo told me that in her youth she had seen twenty-five *huamáshus* in one *Annona* tree, eating annonas. Probably like the weasels they are great wanderers—the fact that a blind baby rides in his mother's fur would indicate such a habit. Huamashu ate any fruit, cooked vegetable, bread, or rice. He defended a banana with more courage than a piece of meat, but freshly killed game with more ferocity than a banana.

Tayras have comparatively narrow skulls and broad heads. A gigantic masseter muscle curves over the skull; in the adult the middle of the top of the head shows a deep depression between the masseters. I often wondered what the killing bite of a grown tayra would be like when I remembered Huamashu's formidable baby efforts, made with undeveloped muscles and milk teeth. The jaw is very short and broad, the muzzle does not resemble at all that of a weasel or fisher. When a tayra bites your finger, the feeling of great power is behind the grip. He nervously shifts the bite frequently, but in such short time intervals and for such short distances that, even though you hold him in one hand and pull on your tortured finger with the other, it is some time before you can free it. The tayra is the bull dog of the mustelids.

The neck is powerful, almost as large as the head, and built for shaking heavy prey. The shoulders and forearms are well muscled; heavy muscles reach to the wrist. I never saw Hua-

mashu dig or grub in the earth like a coati, but frequently that which could not be reached with the jaws could be touched with the claws, what could be touched with the claws could be hooked closer and grasped with the hands, and brought to the mouth. Huamashu was always reaching for,



Photographed and copyrighted by H. H. Heller

Looking out and below.—At the time this picture was taken Huamashu's tail had already become an effective balancing organ

grasping, and holding things; he also explored cracks with the claws of his middle digit. I shall never forget what happened to a georgette crepe dress that one night in the dark floated within his reach.

Some of the tayra's morphological adaptations are exceedingly puzzling. In eastern Brazil and the Guianas the tayras are quite different from our Huamashu. Their tails are much shorter and not so heavily haired;

their country is frequently inundated, while Huamashu's is not,—he came from the mountain-sides. A long bushy tail is an excellent balancing organ but an impediment in the water. When I told a zoölogist that Huamashu was not particularly aquatic, that he had learned to run through puddles but refused to enter deep water, the gentleman was surprised, saying that the animal's feet are webbed. The feet are not webbed like those of an otter or a duck, but the broad flat fore paws are somewhat loosely built and the toes are connected by skin to a more distal joint than are those of dogs and cats. Perhaps we may conclude that our Huamashu belongs to a species derived from one of mixed aquatic and climbing habit—a habit almost necessary to a hunter in the Amazonian country—and that his branch of the tayra family has become more strictly one of tree dwellers. I have no doubt his broad paddles would have served him very well in the water.

He was entirely plantigrade in front, and the whole front sole was covered with a pad clear to the wrist, whereas the hind foot was padded only half way, and he trod only on the padded portion.

Huamashu's tail was not prehensile but he could push strongly with it, exerting force along at least half its length. When he was frightened, which was whenever he saw a horse or cow or automobile, his tail hair stood on end like that of a cat, giving the member a tremendous size, but he did not elevate the tail as a cat does hers.

When he was not excited, especially in his youth, Huamashu's attitude toward other animals was exactly what it was toward us, friendly and playful. Rugupi and he were great chums and he played with such dogs as were

willing to play with him, and with our ocelot, Tammany. His play was, however, always a little too rough and persistent for the other fellow. He and the pet coati, Nita, played joyfully together, but Nita must be free and Huamashu tied, otherwise it was not safe for Nita. So long as another animal showed no fear or fluster he had no inclination to attack it but, if it tried to elude him, he grasped it in play and, if it struggled, he then became excited and was transformed suddenly into a magnificent killing engine. Thus a small or defenseless animal had no chance with him. Nearly every time he got loose he killed something. The bill that we had to pay for pet parrots and monkeys amounted to quite a sum. He was never permitted to eat any of them, though to separate him from his prey the protection of a pair of jaguar-skin gloves was needed.

When Huamashu was three months old and about nine inches long, not counting his tail, we took a six-day journey on foot through the drenching forests over a trail criss-crossed by fallen logs. Most of the way he

walked, following a porter and pulling me by a string. His endurance was astounding, his vitality magnificent. I taught him to climb the logs instead of going beneath them by lifting him a bit on the string but, when he got on top, he recognized the log as his natural highroad and usually started to run along it. After a few miles in the rain and puddles he consented to go to sleep in a sack on my back for an hour.

In Pará Mr. Fisher made a cinematograph of him and some of the other animals for Mr. Newman, the lecturer, and in Chicago Mr. C. T. Chapman photographed his playful antics for the Pathé Company, who exhibited the film in their weekly news. Huamashu lived for ten months in the Lincoln Park Zoo in Chicago and never lost his affection and gentleness toward his friends, though I confess one had to be rather hardy to call his play gentle. The Field Museum is about to mount him for exhibition purposes, and I hope his expression of bright interest and friendly playfulness will there greet all lovers of vital, hearty, affectionate wild animals.



Photographed and copyrighted by H. H. Heller

There never was a better companion than little Huamashu



Photograph by U. S. Army Air Service

BARRO COLORADO, IN THE PANAMA CANAL ZONE, VIEWED FROM AN AÉROPLANE

As this picture indicates, the island is covered with a dense mantle of jungle,—a protective armor, it might be called, for it has enabled Barro Colorado to escape the casual despoiler and to preserve intact objects of interest for the visiting biologist

Hunting Stingless Bees

WHERE EAST SEEMS TO BE WEST¹

By FRANK E. LUTZ

Curator of Entomology, American Museum

ONE of the numerous advantages of the study of insects is that interesting and important material is near at hand wherever we may be—on land, at least. When hundreds of different species in our own back yards are living as yet unrecorded lives, probably full of curious ways that possibly man may never quite understand, journeys to distant lands are not essential to success. Fabre, the most widely known of all entomologists, showed what a stay-at-home can do; his work illustrates also how narrow such an one may become and how desirable it is to see beyond the confines of Sérignan.

At any rate, a museum man does not always have a choice in this matter. It was my task to get the nests and young of several species of stingless honeybees, as well as notes on their habits. Such tropical creatures as *Trigona* are not to be expected in New Jersey even though I did once catch in the northern part of that state an equally tropical bee, a magnificent *Euglossa*, feeding at my petunias. Such being the case, I started for Panama. We called at ten Haitian ports on the way, and the cordiality of the people at these ports and the attractiveness of the country would under different circumstances have strongly tempted me to cancel the rest of the trip; but, while Haiti is noted for many things, I could not persuade myself that the particular kinds of stingless honeybees I had set out to get were to be found even there.

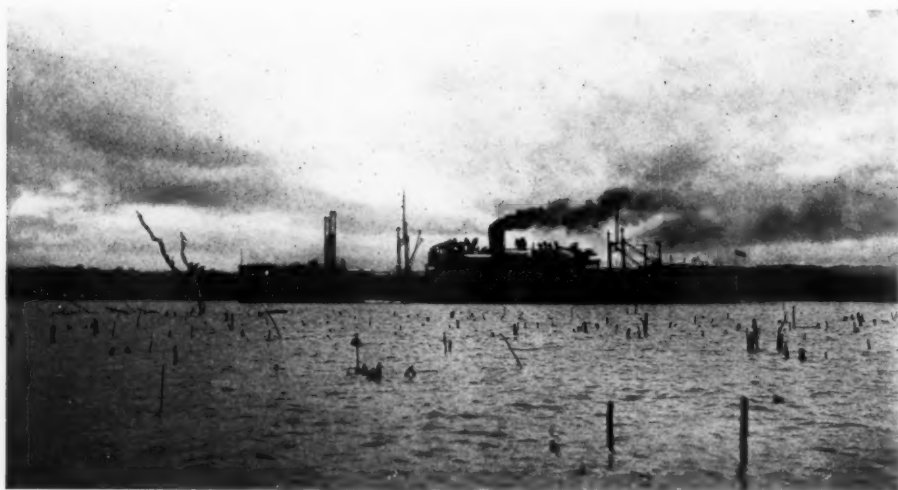
In due course of time, I reached the hotel at Ancon and, putting my little

"Sunday net" in my pocket—it being really Sunday—started to explore. Interesting insects are to be found even in cities. It is just as I said in my opening sentence and here is a proof of it. Not a hundred yards from the Tivoli I saw a stingless bee—a red-bellied *Trigona*—fly up from the edge of the cement pavement; then another and a third.

As a matter of fact these bees had a nest under the pavement, and the surprising thing about its location was that the species concerned was supposed to nest in hollow trees. I wanted not only specimens but a close look at the entrance to the nest. Thirty-odd years of collecting insects has somewhat hardened me to the gaze of passers-by, but this was my first day in the country and it was Sunday and the streets were rather crowded and, what is more, it really is not quite the thing for a dignified, bearded American to be seen on his hands and knees on the pavement that close to the boundary between Ancon and Panama city. People might not understand.

Fortunately, there was a low iron rail along the edge of the walk, so I sat on the rail as though I were resting or waiting for some one. It is all right to do that. And if one drops something in the grass, it is all right to stoop over to hunt for it. Watching my chances, I was frequently able to take my net out of my pocket, catch a bee, and put the net back again without attracting much attention. Once or twice I even had a chance to blow tobacco smoke down the hole in order

¹Photographs by the author



Where the ocean liners now cross from the Atlantic to the Pacific, there was formerly a barrier of jungle. A dwindling, denuded remnant of this forest still shows above the surface of the water. Note the bird perched on one of the forking branches of the most conspicuous tree, undisturbed by the approaching steamer

to make the bees come out in greater numbers.

The next day I suggested to Acting Governor Walker that it would be nice to have the cement pavement taken up



On the left is Mr. James Zetek, to whom the expedition of the American Museum to Barro Colorado is indebted for counsel and other aid in carrying out its plans. Mr. John English, on the right, also gave valued assistance

so that I might get the nest. Although he had already granted me many favors, his only reply to this suggestion was a cordial hope that I might find a nest of the same species in some less expensive place. This seemed reasonable and, with the kind help of Mr. James Zetek, I made arrangements to go to Barro Colorado.

Before the Canal, including Gatun Lake, was constructed, Barro Colorado was a high hill. Flooding the surrounding country made it an island, the largest in the Canal. Recently the government has set it aside as a biological reservation, and steps have been taken to establish there a station for students of tropical animals and plants. The nearest point on the railroad is Frijoles, the location of a plantation in charge of Mr. John English.

Mr. English came to Panama from Jamaica to work with the French on their canal and, except for short intervals, has been in Panama ever since. His skin is black but, like many of his



Unrelaxing attention to problems of sanitation, epitomized in the campaign against the mosquito, made possible the building of the Canal. Today the construction of ditches for the purpose of drainage and in the interests of disease-prevention still goes vigorously on under the direction of Mr. J. B. Shropshire, Sanitary Inspector of the Army, and others

race, he is "white" in his dealings; kind, efficient, interested in nature, and eager to help. It was through him that I bought a *cayuca*, or native dug-out canoe, and hired Murillo. Murillo was also black and kind, but not much else.

The *cayuca* having been loaded with our camping outfit and other duffel, Murillo and I started for the island late one afternoon. However, when we reached the more open water of Frijoles Bay, we found that a wind was ruffling the surface of the Canal to



Murillo paddling a native *cayuca* near the scene of his initiation into the trials and tribulations of an assistant in scientific collecting

such an extent that riding in an overloaded *cayuca* was exciting. Murillo assured me that he was not afraid for himself but that he did not want anything to happen to me. Neither did I, so we went back to Frijoles and I stayed with Mr. English until the next morning.

On our second attempt we reached the island after about two hours of pleasant paddling in the early light of the sun, rising in the east, to be sure, but out of the Pacific, this confusing phenomenon being due to the twisted position of the isthmus. Mr. Shannon of Washington had been working on the island earlier in the season and had built a small shack at the head of an inlet, which we named Shannon's Cove. The shore of the island, being the old mountain-side, is steep. "Barro" means clay in the dry season and slippery mud in the wet, the season in which we were there; and, although Mr. Shannon had been gone but a

short time, the trail to his shack was already partly overgrown. However, we made a landing after unintentionally disturbing an alligator or one of its near relatives, and Murillo started to clear the trail. He had gone only a few yards when he yelled "*Pica! pica!*" and came back running, jumping, and sliding. He had cut into a bush containing a wasp's nest, and *pica* means sting or something of the sort. I was having a little *pica* of my own because I had carelessly caught hold of a prickly stem to keep from slipping, so he received scant sympathy and a request to leave the wasps' nest alone until I had time to collect it. This was a new angle to him, for he had never before been out with an entomologist.

The shack had a floor and a roof. The three open sides were screened with copper mosquito netting except for the doorway, and there was no door in the way, so that, on the whole, the enclosure made a rather good trap for

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SHANNON'S COVE

This inlet Doctor Lutz named Shannon's Cove in honor of Mr. Shannon of Washington, who earlier in the year had constructed a shack at its head. The view shown on the left is that on which the eye rested as one looked out from the shack. The picture gives a good idea of the sculptured coast of the island with its many indentations.

Before the construction of the Canal, Barro Colorado was a hilltop, and although water today covers its base and reaches far up on its side, its mountainous character is still traceable in the steepness of the banks up which the traveler scrambles—often painfully, for the support at which he grasps to steady himself may easily prove to be a prickly growth.

THE CAMP IN THE COVE

The unoccupied shack of Mr. Shannon, discernible in the center of the picture on the right, simplified the housing problem of the expedition, affording a roof overhead, even if a leaky one, and plenty of fresh air, which, along with sundry other things, found free admission through the doorless entrance. Indeed, due to the fact that the shack was screened on three sides, it proved an excellent insect trap, being visited even by the stingless honeybees which the expedition wanted particularly to study.

The incisions made in the jungle by trail-cutting are quickly healed, and in time not even a scar remains, abundant verdure covering over the area laid bare by the machete. The trail to Mr. Shannon's shack, which had been only recently cut, was partly overgrown at the time of Doctor Lutz's visit.





The thorny protuberances with which the trunk of this tree is armed are suggestive of the spikes of ancient armor, and it is easy to yield to the temptation of thinking that their function is protective. The bulbous formation near the base is a termites' nest. The structures made by these insects are now and then occupied by stingless honeybees—sometimes as joint tenants with the builders, at other times as their successors

insects. As the roof leaked, I pitched a tent inside of the shack and, with an air mattress to sleep on, was very comfortable indeed. There were no mosquitoes. When night came, Murillo was somewhat disturbed by the absence of a door and he was quite alarmed when he discovered that I had no gun. He blocked the doorway with a poncho and took his machete to bed with him.

The vegetation of Barro Colorado is jungle of the hilltop type; and a tropical jungle gives us a feeling which is difficult to describe. Apparently it is not possible to describe even the jungle itself so that those who have not been in one can understand. It is more than monotonously varied dense woods bound together with vines, many of which become trees. Its essential features are not moisture-dripping leaves and gloom. Monkeys may swing from the branches and brightly colored birds may make noises that are as unpleasant as the appearance of the birds is pleasing, but they are not the jungle. Life's struggle seems, but may not be, more strenuous there than elsewhere, but jungle is more than all of these. It is *jungle*, indescribable, fascinating, and, to the biologist, an environment of extreme interest.

However, travelers in the tropics have been so impressed by the jungle and have so impressed their readers with it that many people think of the tropics as one vast jungle except where man has made a clearing which he must continually defend against the jungle's return. That is not the case. Savanna, grassland, desert, and open swamp in the tropics are just as truly a part of the tropics, and each has its interest.

Another mistake is the idea that one cannot get about in a jungle without cutting a trail. Usually one can, but a trail is a great convenience. Making



A wall of verdure rising from the water's edge and crowned by the graceful, spreading fronds of a palm

one's way through a jungle is sometimes almost or even quite as bad as going through a tangle of cat briers or a swamp thicket in New Jersey, and when you have a negro whose chief virtue is his ability to swing a machete success-

fully, it is foolish not to have a trail. Furthermore, many jungle insects gather in such open spaces and are more easily caught there.

Accordingly, I set Murillo to cutting a trail straight across the island,



JUNGLE CONFLICT

Plants of many kinds are competing for a root hold and are crowding one another in an attempt to win a place in the sun



CLIMBING PLANTS OF THE JUNGLE

Climbing plants use tree trunks as their ladders; and lianas, like taut tent ropes, hang from the upper branches of the lassoed trees

directing his course with a compass. This trail led us up hill and down gully. Even when completed, it was not exactly a place for a thoughtless stroll, especially at that season of the year when the almost continual rain made



A section of the trail which was cut from one side of Barro Colorado to the other under the direction of Doctor Lutz

barro slippery, but it did serve as a good collecting ground and I swung the net as Murillo cut. In fact, whenever I started back for camp, he came too, assuring me that he was not afraid to be on the "mountain" alone but that

it was safer when we were together, especially as we had no gun.

The second evening on the island I collected the wasps that had so frightened him when we arrived. Apparently he had been watching me during the day because, after we had gone to bed and I was nearly asleep, he asked if he might speak to me about something. He recalled that out on the trail I had held my hand so that a large and "very bad" black ant crawled on it and then I had let this terrible creature walk up my bare arm while I examined it with my glass. I not only did not die but did not seem to suffer any pain. Then I caught hundreds (a gross exaggeration) of wasps and took their nests without being stung. What he wanted—and if I gave it to him, he would work for me without further pay—was some of the "medicine" I used to keep from getting hurt. I told him the only medicine I had was a moderate amount of "gray matter" and that I could not spare any, but, as my Spanish was not much better than his English, he did not understand. In following days, when I was not quite so sleepy, I tried to show him that wild things are not dangerous if you act properly toward them, but still he did not understand.

Stingless bees of several species were common on the island. A certain kind, a small black one, was very abundant and very fond of our food-stuffs, getting into everything from bacon grease to sugar and condensed milk. These bees would enter the shack and then buzz against the wire netting like flies on a window pane. This was an opportunity for large ants like the one that did not hurt me to pounce upon and eat the bees, thereby securing a combination of meats and sweets that must have been very good. However, though these bees were

abundant, they were of the same species that occurred on the mainland; the density of the jungle on the island made it difficult to locate nests; and the dampness made it necessary to keep all specimens of insects on a rack over a slow fire so as to prevent molding. In Ancon a very convenient, electrically heated drying closet was available and the cooking at the restaurant was somewhat better than either Murillo's or mine; so, after about a week, I returned to Ancon.

Another reason for leaving the island was that in our trail-cutting we had found nothing but jungle. Other types of environment also were desirable. Realizing that our trail covered only a small part of the ten or twelve square miles that constituted the island, I thought it would be well to explore Barro Colorado from the air. Accordingly, through the great courtesy of the Army Air Service, Lieutenant Foster took me up in a plane after I had signed a lengthy document which clearly and definitely placed upon me all blame for any unfortunate thing that might happen and told survivors what to do with my remains. The flight was disappointingly pleasant and without thrills, but I satisfied myself that the island's vegetation is fairly homogenous except for several small plantations along the edge. It is a magnificent piece of Panamanian hill jungle and, in view of the rapid extension of cultivation in the Zone, it is most fortunate that such a place has been set aside for future generations. The fact that it is now an island makes preservation particularly easy.

Returning to Frijoles, I heard of a large nest of some very vicious hornets on a tree in the plantation. They turned out to be of a sort that inspires caution, but I wanted some of them

and, as I could not reach them with my net without placing myself at a tactical disadvantage by climbing the tree, I threw a stick against the nest by way of inviting them to come down. They came, directly and numerous. Swinging my net around my head like an Indian club I easily got all the wasps I wanted and, fortunately, did not get stung. When things quieted down, I looked around the horizon for Murillo, but I was mistaken. Instead of trying to match his speed against that of justifiably enraged hornets, he had dropped face-down on the ground. His dirty clothes were a good match for the earth, and his head seemed to be a rock covered with black moss. He was certainly "protectively colored," but his immobility was what counted and he maintained it until repeatedly



To prevent molding in this region of much rain the insects that had been collected were placed on a rack and dried over a slow fire

assured that all was well. I really think Murillo was relieved when his term of employment with me ended.

On a tree near the one which contained the hornet's nest there had



MAKING THE MOUNTAIN COME TO MAHOMET

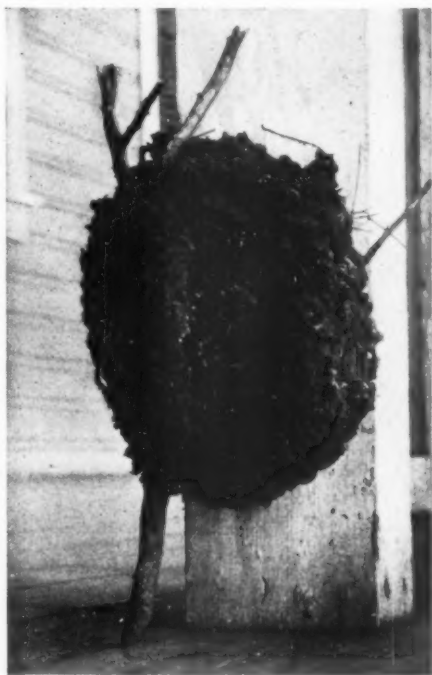
Attached to the lower surface of the left limb of the tree (topmost picture) is a large hornets' nest. It was so situated that an inspection at close quarters would have placed the collector at a tactical disadvantage, even though the surface appearance of the nest (picture on lower left) showed no signs of the stinging hordes that inhabited it. Then a stick was tossed with well directed aim and struck like a bombshell on this citadel of the wasps. Instantly an enraged host of insects poured out (picture on lower right) and the collector secured several specimens that flew to attack him

been two nests of stingless honeybees, the same small black species which was so abundant on the island. Some one had cut off the branch holding one of the nests but, although the nest was lying sideways on the ground, the bees were still using it after having made certain interesting alterations. These nests had been made by ants but the ants had moved out and the bees had moved in. Curiously enough, the entrance which the bees make to the interior of the nest is on top and funnel-shaped as though designed to catch rain, and this seems foolish. The brood cells are arranged in horizontal layers within. Now, the nest which had fallen and was lying on its side had two entrance holes: the old one, which was on what had been the top of the nest, and a new one, which was on what was subsequently the top. Furthermore, when the nest was opened, it was found that the layers of brood cells were in two planes: one the old horizontal and the other the new.

Some stingless bees make use of termite nests. Beautiful examples of such use were seen in a swamp jungle near France Field, which I visited through the kindness of Mr. J. B. Shropshire, Sanitary Inspector of the Army. There the termite nests were two or three feet in diameter and built on the trunks of trees not far from the ground. The termites were still using most of the structure, but the bees had made an entrance of their own and were using the remainder.

Some stingless honeybees are not very choice in their diet. Raids on our larder in camp have already been mentioned but the garbage cans in Panama City were also popular and I have caught such bees on manure and on dead snakes. As far as I know, all of

these bees obtain most of the material for making honey from flowers. An observation made near Sabañas was therefore of interest. While waiting for a car I noticed many *Trigona* flying in and out of a brush pile in which grew a rambling *Solanum*, a plant related to our potato and tomato. Thinking



A nest of stingless honeybees.—The nest covering has been removed on one side to reveal the arrangement of the combs within

there might be a nest there, I carefully parted the brush and found not a nest but the thing that was attracting the bees. It was a colony of immature "insect Brownies," small, curiously shaped creatures belonging to the family Membracidae, that were feeding on the *Solanum* and having their secretions fed on in turn by the bees. Some of our ants attend colonies of plant lice in much the same way.

Just before leaving the Zone I made

a trip, again through the kindness of Mr. Shropshire, to old Fort Lorenzo, with its damp and dismal dungeons still bearing evidences of the Spanish tortures, its battlements, and, from my standpoint not the least interesting, its bees peacefully nesting in the ruined masonry. A better than Murillo was my guide. Mr. Shropshire had told him I was coming and what I wanted, so he had located numerous nests. In taking me to them he saved the best nest for the last, and the fact that it was necessary to wade through swamps with water nearly to our waists in order to get to it was of little moment because the rains had soaked us already. The nest belonged to that red-bellied

species of *Trigona* which the Acting Governor had hoped I would find in a less expensive place than under a pavement in Ancon. Here it was and in a hollow stump as it should be. Unfortunately, my guide, in an excess of righteous but misguided zeal, had opened it the day before in order to make certain that it was worthy of the attention of one of Mr. Shropshire's friends. In doing so, he had broken the large entrance funnel but the pieces were still there and from the nest itself I obtained some interesting biological material. There was also a quantity of rather acid honey with which we refreshed ourselves before wading back to higher ground—and home.



The protruding top of a submerged stump, upon which a number of different plants have established themselves, forming a beautiful natural jardinière. A wasp's nest of elongated shape is seen near the center of the picture. This nest was collected with the hesitant co-operation of Murillo, who paddled the unsteady canoe in which the approach was made



Into a little-known area of western Panama the expedition of the American Museum penetrated during February and March of 1924. After gathering valuable data, Mr. Griscom and his associates were compelled to make a hasty exit due to the hostile attitude of the Indians. Their route is shown on the map, which was prepared under the supervision of Mr. Griscom by W. E. Belanske

Bird Hunting Among the Wild Indians of Western Panama¹

By LUDLOW GRISCOM

Assistant Curator, Department of Birds, American Museum

BETWEEN the Volcan de Chiriqui and the Pico Calovevora in Veraguas lies a mountainous country unexplored and unvisited by white men, inhabited only by wild Indians. No knowledge exists regarding its topography. The courses of the rivers of the interior and their tributaries are pure guesswork, the location of the higher peaks varies from map to map as much as twenty miles, and their altitude as much as 2000 feet! While the avifauna of the Volcan de Chiriqui is essentially that of the Costa Rican highlands, Arcé secured sixty years ago many peculiar types in the

mountains of Veraguas, and this has stimulated curiosity as to what kinds of birds occur in the intervening unexplored country.

With Dr. Frank M. Chapman's cordial coöperation and approval I left New York February 5, 1924, accompanied by three assistants, to make a preliminary reconnaissance of the region. Mr. Rudyerd Boulton, of the University of Pittsburg, an experienced student, was invaluable not only because of his scientific knowledge, but also in his capacity as photographer of the expedition. Mr. George A. Seaman, a young collector of promise, was

¹Photographs by Rudyerd Boulton

to remain in Veraguas to make thorough collections at the localities of special interest. Mr. J. Manson Valentine, of Yale University, was a volunteer, who excelled all of us in his ability to make an artistic and perfect birdskin. In Panama I was fortunate in securing

friend, Don Rafael Grajales, the leading citizen of Remedios, who telegraphed most emphatically that the trip to Cerro Santiago in the unfrequented region was possible, that he could obtain guides, and that his house and assistance were at my disposal.



The Indian chief in front of his hut at Cerro Iglesia, Mr. Benson on his left, the author on his right. Huts of this type never have side walls. The rain is kept out effectually by means of a very thick, overhanging thatch of dried banana leaves and stalks. When the thatch leaks, it is usually due to the tunnels made by rats, a colony of which can be found in almost every hut

the services of Mr. R. R. Benson, who had lived for years in Veraguas, and acted as a most efficient *mayor domo*. At Balboa Mr. James Zetek, the government entomologist and director of the recently created research station at Barro Colorado Island in Gatun Lake, was most kind in helping me secure the necessary permits and other papers from the Panamanian government. He happened to have an intimate

It was a great relief to arrive in Remedios after a hard five days' ride with the pack train from Santiago. One of the inconveniences of an ornithological expedition is the bulk and weight of the baggage, and poor Benson almost tore his hair in his efforts to reduce the loads of the few animals he had been able to find. Nothing could have surpassed the hospitality and cordiality with which we were re-

ceived by Señor Grajales and his kind lady. But our fond hopes of at last obtaining definite information about the mountains of the interior were doomed to disappointment. Nobody in Remedios had ever heard of the Cerro Santiago, and they called the mountain back of the town the Cerro Flores. Nor had anybody ever been in the interior, and two years before a couple of Panamanians who had gone there to take a census of the Indians had been killed. Unless the Indians themselves, therefore, would guide us into their own country, there was not the remotest prospect of our reaching the mountains, much less of making a sojourn there.

It was in this connection that Señor Grajales was able to be of the greatest assistance. A certain number of the Indians had been coming for years to Remedios to trade and some among them spoke Spanish. Señor Grajales, by dint of years of fair and honest dealings with them, had won their confidence and respect; they trusted his word and accepted his recommendations when they would follow the counsel of no one else. He knew the chief of the whole district, who lived at Cerro Iglesia, a particularly intelligent man, who had been at Remedios a good deal and spoke Spanish fluently. To him he wrote a letter introducing us, stating the purpose of our visit, and that we were friends of the President of Panama. The important part of the letter, however, was that we were North Americans from a distant country, that we were not looking for gold, that we would stay in his country not more than thirty days, and would then leave *never to return again*. This will acquaint the reader with the main objections of the Indians to strangers. Poor victims of the white man that they are, we cer-

tainly appreciated their point of view. For four centuries bitter experience has done nothing but confirm it. Their association with strangers has invariably resulted in trouble and disaster. The craze for gold has led to inrushes of outsiders, who by some extraordinary hocus-pocus, declare they own the land which the Indians have considered theirs from time immemorial. All too frequently the arrival of strangers in their midst has been attended by more flagrant types of outrage and abuse, and they know that the stores in the coast town systematically cheat and rob them, though they are too ignorant to devise ways to prevent it. May they long enjoy the quiet possession of their country in their primitive simplicity, undisturbed by a civilization which they cannot assimilate and which would probably destroy them!

Armed, then, with our letters and documents, we set out on February 28, conducted by a friendly alcalde to the hut of an Indian on the border of the Indian country. This Indian was to guide us next morning to his chief. It was with the greatest difficulty, however, that he was induced to do so, and it was obvious that our presence was strongly resented. The following day an arduous trail brought us to the Cerro Iglesia, where we were to have the all-important interview with the chief. In spite of the fact that we had cut down weight by every possible expedient, and that our provisions were reduced to little else than rice, beans, coffee, sugar, and lard, my two mules and five horses were barely able to make the 70° grades of the trail, which was a mere footpath for bare-footed Indians. The loads were constantly slipping or tumbling off altogether, the tired animals were forever falling, and were exhausted at the end of the day.



View from the chief's hut of the country penetrated by the expedition.—The Indians have repeatedly cleared the country for agriculture, but the low invading scrub in the foreground, full of ticks and "jiggers," has tended to defeat their efforts

Our arrival at Cerro Iglesia occasioned no surprise. The chief, whose Spanish name was Aquile Sanchez, received us with all hospitality, for he had been informed three days before that we were coming. Indeed, I had occasion increasingly to admire the remarkable manner in which news traveled among these Indians. Aquile was less squat and low-browed in appearance than the majority of his compatriots, and his face was ornamented with blue paint.

Indian hospitality has its decided drawbacks. These people live very largely on corn prepared in various ways, one of the commonest being that of soaking the cracked kernels in water until the fluid becomes milky. The drink of ceremony is made from this mash, and is known by the Spanish

name of *chicha*. The mash is thoroughly chewed and spat into a fresh calabash, and then put in the sun and allowed to ferment. The taste is nasty and, needless to state, the drink is the reverse of appetizing, due to the manner of its preparation; but it is a mortal insult to refuse it or to show disgust. An Indian of proper spirit would have drained a whole calabash filled to the brim, but I satisfied requirements with a few mouthfuls. As leader of the expedition I was forced to "sound off" under the critical eyes of my lieutenants, but as I succeeded in maintaining outward calm and equanimity, was in the strategic position of requiring them to do the same under threats of dire penalty. They trooped up in line, for all the world like children to take their castor oil, though my opinion of the latter



This photograph is virtually a continuation of the view on the opposing page. The higher mountains, covered with clouds, show dimly in the distance, about thirty miles away. The bird life in the intervening area proved to be very scant because of the deforestation

beverage has soared since sampling Guaymis Indian *chicha*!

After the proper interval of small talk that etiquette demanded—for undue haste would have been most unseemly—we addressed ourselves to the business in hand. The letters were read to the chief, and our business and desires were explained; but he could scarcely believe we really were interested in birds, never having heard of any such lunatics, and he wanted to know if my prism glasses were not gold detectors that would reveal the presence of the precious metal at a distance or underground! But learning that I was a scientist, he asked me to cure one of his wives who was sick. The fact that she was a day's journey away, and that he was quite unable to describe her symptoms, did not appeal to him in

the least as handicaps, and I suspected he thought that failure to effect a prompt cure would prove I was not a scientist after all. Experience in Nicaragua had taught me, however, that most ailments among such people were of a very simple kind. I accordingly produced ten grains of aspirin, ten grains of quinine, and a powerful laxative pill, confident that one of them would fit the case, and the other two do no harm. My orders were to take the whole lot before going to bed! They were given and accepted with the greatest solemnity on each side, and the Indians were impressed with my portable medicine case, which I produced with as many airs and flourishes as possible. I had the satisfaction of finding out later that the following morning the patient was cured.

In the meantime we had found Aquile a more and more likeable and trustworthy fellow, and made a strong bid for his friendship. I exerted myself to the utmost to persuade him to come along as guide, philosopher, and friend, and see for himself that we were really going to do what I said. As an inducement I offered him about twice as much in the way of wages as a Panama Indian ever received before. He would have no duties to speak of, but I calculated that his presence would insure our safety, and that he would obtain food for us when the Indians would sell us nothing. He finally promised to join us in three days, and in the interval assigned us one Toribi as guide. As it turned out, the trip could not have been made without Aquile.

The next three days we spent in a ceaseless struggle to get the pack train over the narrow Indian trail, which did not deviate from the crest of the ridge, as though it were insistent upon following the path of adventure. It was probably centuries old, as in places it had been worn down to a cañon ten feet deep and three feet wide, and at such depressions the packs had to be unloaded and the baggage carried through piece by piece. The farther into the interior we advanced, the drier the country became and the steeper the slopes. Water was at the bottom of the gullies, and after one had obtained a drink it required a half hour's exhausting climb to return to the heights. Our compensation was a magnificent view. The whole country to the east, west, and south lay open before us, the shimmering Pacific in the distance, and some sixty miles to the northwest the gigantic Volcan de Chiriqui loomed purplish in the haze. The last day the country became posi-

tively arid; there were practically no trees and the slopes, excessively steep, were sparsely covered with brown grass, while the escarpments of red sandstone were naked. This section formed a belt or zone about ten miles wide just before the main range was reached. Here conditions changed with startling abruptness. Influenced apparently by the cloud-and mist-zone above, the barren, stony slopes became covered with heavy forest without the slightest zone of transition, and this forest stretched unbroken to the Caribbean. The photograph shows this condition of affairs near our base camp, which was pitched just inside this forest, marking the northern limit of the Guaymis country. Aquile informed me that on the other side of the mountains dwelt other Indians, who were very wild, bad people with whom they had nothing to do!

Penetrating the barrier of dense forest, we camped on the slope of the Cerro Flores at 3700 feet, and here we spent ten fruitful and fascinating days. We were in the heart of the subtropical zone, and the avifauna was entirely different from that of the lowlands. Every morning the party scattered in four or five directions, and it was very exciting to meet at noon, and see what the combined bag contained, and who had done the best collecting. Every day brought additional species, or another specimen of some choice rarity, such as a thrush, tanager, or quail dove.

Collecting was, however, difficult. The ground birds were shy and secretive and exceedingly hard to find in the dense jungle. Most of the others were in the tops of the tallest trees, practically out of gun shot, or scarcely visible because of the abundance of the intervening leaves. Thus while the



This photograph shows the abrupt change from the open grassy slopes to heavy primeval forest. Note the steepness of the slope. The camp of the expedition was just inside the forest area at the left of the picture



A view of the camp at 3700 feet in the heavy mountain forest shown in the preceding picture. The blackness of the shadows and the intensity of the light in the little clearing made photography difficult

bell bird was common, and its extraordinary note, like the clang of a hammer on an anvil, rang out constantly over the forest, only two specimens were secured. One day a great flock of giant swifts was discovered darting around the summit of a bare peak, their wings making a humming sound, audible for a mile. The difficulty of shooting ducks on the wing paled into insignificance beside the feat of hitting these arrow-swift darters, which, as though shot from a bow, were carried by their momentum for several hundred yards. That day we tried giant-swift pie for lunch, as every morsel of meat was precious. Although quite tender, it tasted like a cross between ashes and string, which I trust did not impair its nutritive value.

In the meantime I spared no effort to devise some way of reaching the cloud forest above us. A day's scouting trip with Benson and the Indian chief furnished experiences which any naturalist might envy. We reached the continental divide at 6000 feet, and could look off forty miles or so to the northwest, where lay the Caribbean lowlands. To the west about ten miles away rose a cone-shaped peak about 1000 feet higher than the crest on which we were standing, with a big break in altitude between. Perhaps it was the real Cerro Santiago. The forest had changed with the altitude to a gnarled and stunted one, and every tree was loaded with parasitic plants of many kinds. Above 5000 feet the very ground had been left behind, and we struggled upward in a gigantic bed of moss of unknown depth, with manholes between the roots of the trees, through which we could have dropped as much as fifteen feet. Everything dripped with moisture, everything was slimy and

moldy, and everything gave way at one's touch. The slopes were markedly precipitous, with the result that water was unreachable in some gully 1000 feet below. There was not a square yard of even gently sloping hillside and there was no dry wood. A camp in the cloud forest was impossible.

The bird life was utterly unexpected. Not a single one of the mountain species found farther east occurred here. Instead, the fauna was obviously that of the Costa Rican highlands, but with this difference, that isolation and remoteness were accompanied by a certain amount of variation. Several at least of the birds obtained are new subspecies. Benson shot a new species of *Scytalopus*, small wrenlike birds of secretive habits, and I collected a very distinct new species of a peculiar finch (*Pselliophorus*), hitherto the only member of its genus. It was the reward of the explorer that, at the very least, every bird found automatically extended its range far to the east.

The highest point at which a camp could possibly be established was 4500 feet. Here Valentine and I spent two days, ascending to the cloud forest and collecting each day. An Indian runner carried our birds to the base camp to be prepared by those remaining below. At the end of the second day we returned to the base camp for a rest, expecting that two of our party who had remained below would have their turn up above. But our reduced food supply was sufficient only for five more days, our three Indian porters had melted away, and the chief was leaving at dawn. Something was wrong! Next morning, when I paid off Aquile, I added a considerable gratuity with my expressions of friendship, hoping he would be induced to say something definite. His response

was to send back a message by means of a boy from the nearest Indian hut to say that we must not leave camp and to keep watch night and day. Our muleteer was dispatched to the hut, and came back with the information that the whole country was seething over the fact that strangers were in their midst. The chief was accused of betraying his country and of having sold the Cerro Flores to us for the gold it was supposed to contain! Poor people, they could not believe we were collecting birds, and our tents and belongings were so much better than anything they had, that they were convinced we were permanently settled. So the chief was to be killed and we were to be gotten rid of. But the chief's brother, overhearing these plans, slipped out the night before to bring Aquile word. While it was impossible to verify these rumors, common sense and the fate of our two Panamanian predecessors compelled us to take them into consideration. To stay at all, would have necessitated splitting the party to obtain more provisions. Benson and I would have had to make a flying trip to Remedios, meantime leaving the three younger men alone. Under the circumstances this would have been sheer folly. The council of war had no trouble, therefore, in reaching the conclusion that there was nothing to do but depart at once, and run no risk of jeopardizing the equipment and our precious collections, not to mention our own lives.

Sending to the Indian pasture for the horses started the word that we were leaving. We broke camp at once and packed up in a pouring rain. I had to ascend to the higher camp and bring it all down on my back. Toward evening a significant event was the sudden return of the chief and three other

Indians, who helped us load the animals. At 11 P.M. in bright moonlight the retreat started. The Indians dropped off to their homes about 1 A.M., and Aquile turned off, too, to pick up his wife, whom he had left in some hiding place, promising to catch up with us later, by means of a short cut impassable for our pack train. Going all that night and all the next day, we arrived at Cerro Iglesia about 5 P.M., men and animals thoroughly worn out. A brief stop for coffee was made during the morning, and here Aquile and his wife overtook us. All during the night we had heard the Indians hallooming and calling in peculiar tones and cadences from ridge to ridge, and we felt sure they were signalling our departure. The following day we were glad to reach the hospitable quarters of Señor Grajales at Remedios. To our surprise, the chief insisted on accompanying us. Once out of the Indian country, he talked freely. The rumors proved to be absolutely correct, and we had the satisfaction of knowing we had done the right thing. In fact, so trustworthy did the rumors seem to the chief, that he had not the slightest intention of returning home without various documents from officials, restating the objects of our visit, the services he had performed for us, and the fact that we had gone home, *never to return again*.

After several days' rest at Remedios, we proceeded to Santiago, chiefly by boat so as to see more of the country. After re-outfitting we proceeded by launch to the San Lorenzo River on the coast. Here for two weeks we were the guests of Mr. A. R. Wilcox, president of the Tropical Lumber Company, who could not have done more to make our stay a success. The camp was in the heart of a heavy



A superb mahogany tree on the land of the Tropical Forest Products Company.— Mr. Wilcox measured this tree, which, he ascertained, was 7 feet in diameter 6 feet from the ground, and 152 feet from the base to the first limb. It took a gang of laborers nearly a day to clear the forest growth about the tree so that a picture might be taken, and a platform 15 feet from the ground had to be constructed to enable Mr. Boulton to include the first limb in his negative. The perfectly symmetrical trunk had all the grandeur of a cathedral column. There were bigger trees near by with even thicker trunks, but they were more irregular in outline and branched much nearer to the ground

primeval forest, and one of the commonest trees was a recently discovered species of mahogany of gigantic size. The photograph above gives an ex-

cellent idea of the superb proportions of one of these trees. Another was 13 feet in diameter 6 feet from the ground. In this forest wild life abounded. At

least 200 species of birds occurred in the surrounding country. Howling monkeys were heard daily, and wild peccary was a welcome addition to our bill of fare. When tired of the forest we took the launch, and had an interesting day with aquatic birds and sea snakes.

My reconnaissance work was now

concluded, the objects of the expedition had been attained. Seaman and Benson are now actively collecting, on a schedule that will take a year or more to complete. Three days later in the bustle of Panama City, the mountains and the wild forest seemed far away, like the incidents in a pleasant dream.



Brown pelicans inspecting the boat in which the expedition made its return over the Gulf of Panama



Ateniella bombycina, like other psammocharid wasps, specializes in the capture of spiders. Her long legs enable her readily to drag her prey along the ground

The Huntress of Spiders, *Ateniella bombycina*¹

By WILLIAM M. SAVIN

TO one unfamiliar with the fact that related insects are frequently of widely divergent size, it is somewhat surprising to learn that the little *Ateniella bombycina* belongs to the same group as the large *Pepsis*, the tarantula-killer of our West. Both are solitary wasps of the family Psammocharidæ,—the Pompilidæ of the older classifications. All the female members of this family specialize in capturing and paralyzing spiders, but in their method of carrying the helpless victim as well as in the technique of nest construction they differ somewhat from species to species and sometimes even from individual to individual. Many of these wasps drag their spiders as they make their way walking backward through a forest of grass, over irregularities of the ground, or even up the sheer wall of an embankment,—mountain-high when compared with the size of the insect; others manage to carry their burden by half-running and half-flying, but without rising from the

ground, while of one species at least it has been recorded that in crossing a body of water the wasp will fly close to the surface, "trailing the spider and leaving a wake that is a miniature of that of a passing steamer."

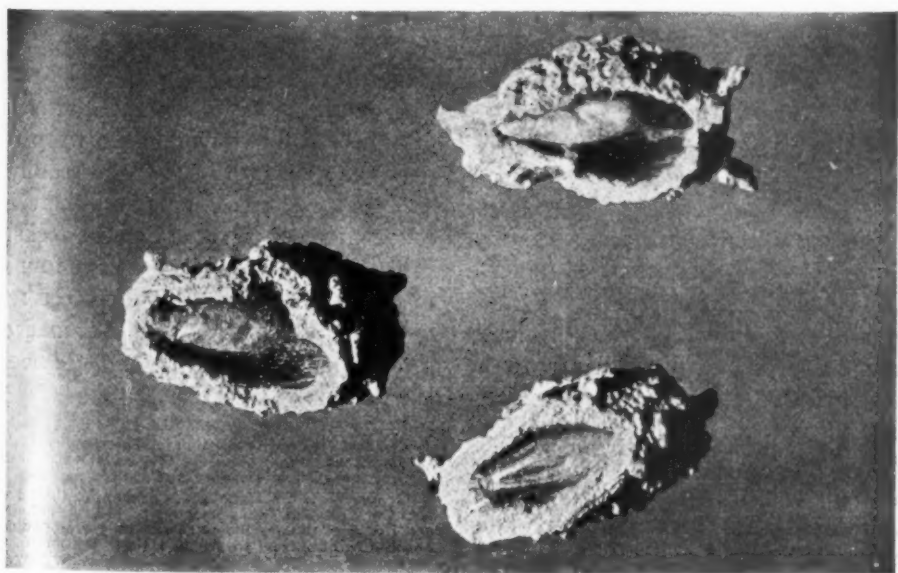
A number of species of Psammocharidæ dig burrows in which the wasp entombs the spider, destined to be devoured piece-meal by the wasp larva that presently emerges from the egg attached to the victim. But other species, instead of excavating in the ground, establish their nursery in the crevices of stone walls, under loose bark, logs, or rocks, in the mud nests of *Sceliphron*, their competitor in spider-hunting, and even in the interior of an oak gall!

When digging the tunnel the wasp often leaves the spider in the crotch of some near-by plant, or on the ground close to the nest, or hidden under a lump of earth, and during the work of excavation, she frequently visits the captive to inspect it.

¹Illustrations from photographs by the author.



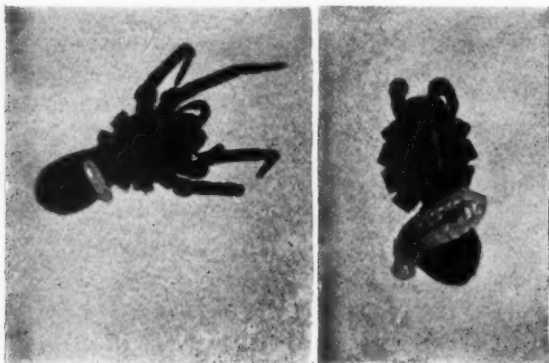
Mud nests of *Ateniella bombycina* attached to the underside of a log lying in a field.— Each cell has been stocked with a single spider left there by the mother wasp as food for the larva which, if all goes well, will emerge from the egg that she lays on the spider. When these cells were opened, it was found that four of them held spiders and three of them wasp larvæ which had devoured the food provided. After pupation the wasp emerges from the flat end of the cell



The underside of three cells removed from the log to which they were attached by the mother wasp. The pupa, in the silken cocoon spun before pupation, is visible in each cell

Psammocharid wasps have chosen a difficult and at times perilous occupation in limiting their captures to the spiders. Certain solitary wasps of other families specialize in seizing flies, beetles, grasshoppers, caterpillars, etc., none of which offers any serious resistance. Of all the psammocharids, the *Pepsis* of our Southwest runs perhaps the greatest risk, for she attacks the tarantula, which inspires almost universal terror. A false move

wasp was able to capture a number of this species.¹ The following year when I found another cluster of cells of *Ageniella*, all contained *Lycosa* spiders. In each instance one might be tempted to think that the wasp had come upon a spider cocoon from which the young were just emerging, but the size of the victims made that belief untenable. All the spiders were adult and must have been long separated from their brothers and sisters.



Lycosa spiders which were taken from two cells of *Ageniella bombycina*; one spider has an egg on the dorsum, the other a larva which has hatched and is devouring the spider.

Before placing the captive spider in a cell this wasp removes some or all of its legs. One of the spiders here shown has had all of its eight legs severed from the body, the other one only four. The two leglike appendages (called pedipalps) near the mouth of the spider were unharmed

on her part, giving an opportunity for the spider to bite her, would mean certain death.

The little *Ageniella bombycina*—the psammocharid to which this article is primarily devoted—often secures spiders larger than herself. She is indeed a skillful huntress, for one year in a cluster of nests that I located under a log I found a grass spider (*Agelena nævia*)—in every cell in which a victim was present. This spider, thanks to the character of its nest, seems better able to protect itself than most arachnids, and of the many nests of the mud-dauber wasps (*Sceliphron* and *Chalybion*) that I have opened none contained a grass spider, yet this little

Ageniella bombycina breaks most, if not all, of the legs of the captive spider. There may be some good reason for this but it is not apparent. It may be simply to enable the wasp to pack the spider in the nest more readily. The spider's legs are long and there is not much spare room in the cells.² Most of the spiders that I have found in the cells had some of their legs removed, but the wasp had not damaged the pedipalps, leglike appendages near the mouth of the spider.

¹Phil and Nellie Rau mention in *Wasp Studies Afield* (p. 125) that on four occasions they have found dead *Chalybion exruleum* in the webs of spiders.

²George W. and Elizabeth G. Peckham in their account of *Pompilus fuscipennis* on p. 143 of *Instincts and Habits of Solitary Wasps* ascribe the corresponding habit of this huntress to the fact that "she makes a very small nest in comparison to the size of her prey."

NOTES

FISHES

ENCOMIA FOR "THE BIBLIOGRAPHY OF FISHES."—In the May-June issue of NATURAL HISTORY a review and an historical sketch were presented of the recently completed *Bibliography of Fishes* and it is not necessary to retrace the facts that were there set forth, but by way of supplement there should be some indication of the reception accorded this monumental work by the scientific world, as evidenced by the reviews prepared by the foremost ichthyologists. It is a tribute to the comprehensiveness of the Bibliography and its adaptability to the needs of special investigators, that it should have been praised by authorities representative of a number of different branches of research, each viewing it critically from his own angle of interest. These reviews, could they be printed in full, would constitute a significant expression of approval, but even the few excerpts from them for which space is available cannot fail to convey the unanimity of the judgment regarding the Bibliography,—a judgment which sustains the steady faith maintained by President Henry Fairfield Osborn throughout the years of its preparation that the completed work would prove one of the greatest scientific undertakings in the history of the American Museum.

J. Graham Kerr, professor of zoölogy in the University of Glasgow and leading student in the British Empire of the embryology and the morphology of the vertebrates, points out in *Nature* that "The great Bashford Dean Bibliography . . . will form an admirable guide to the investigator and learner through the otherwise impenetrable labyrinth of detail," and refers to the work as "one of the most important contributions to zoölogical science which has been made in recent years."

Dr. David Starr Jordan, president emeritus of Leland Stanford and the dean of American ichthyologists, contributes to *Science* a review in which he characterizes the Bibliography not merely as monumental but as "majestic, commanding, and, above all, insistently useful," adding that "no one in the future can attempt research in ichthyology without having these volumes at his elbow."

The leading American student of the osteology of fishes, Dr. E. C. Starks, commenting on the Bibliography in *The American Naturalist*, says that "It might well serve as a model for

a bibliography of each of the vertebrate classes" and expresses the opinion that "not only will the men interested in fishes be under great obligations to Doctor Dean and his colleagues, but comparative anatomists will be also, for the anatomy of the primitive vertebrates is fundamental to an understanding of all anatomy."

In the *Bulletin* of the New York Zoological Society Dr. C. H. Townsend, director of the New York Aquarium, pays tribute to the Bibliography as a work "of such a character that all students of fishes and fishery subjects must turn to it, if they would know what has already been accomplished by those who have preceded them."

Mr. H. T. Sheringham, leading authority in Great Britain on angling, and angling editor of the *Field* contributes two spirited reviews, one to the periodical just mentioned and another to the *London Morning Post*. In the latter he refers to the salutary effects of studying the Bibliography, which has disclosed to him the fact that "besides the trickles of printer's ink in which I have been able to wade without discomfort [pursuing the fish] there is a 'great and wide sea also' where you want charts, and lighthouses, and pilots, and, I begin to think, lifeboats as well." The multiple services rendered by the Bibliography to him who starts on a voyage of discovery in the domain of ichthyology could not be more pithily and picturesquely summarized.

Mr. William Radcliffe, author of *Fishing from the Earliest Times*, in which are presented a host of interesting facts bearing on the folklore and mythology of fishing among the ancients, opens his review in the *London Times Literary Supplement* with the comment "This is a great and thorough work. If its title ran 'The Bibliography' instead of 'A Bibliography' few could object, for it differs from all its predecessors in that it is concerned with but a single subject—fishes and all particulars wherein they touch the life of man. Further, of no other branch of the animal kingdom does there apparently exist so complete a compendium of its literature or one so minutely digested for the reader."

A bibliophile's opinion regarding the work is registered in *Public Libraries* by Mr. H. M. Lydenberg, reference librarian at the New York Public Library. Referring to the section containing the pre-Linnæan titles, he

says, "Biologist, anthropologist, student of folklore, historian, psychologist, any student of beliefs of former days will have far to go before he finds so extensive and accurate a guide to the sources for scientific thought of yesterday."

Dr. R. P. Cowles, associate professor of zoölogy in the Johns Hopkins University closes the appreciative review he contributes to *The Johns Hopkins Alumni Magazine* with these words: "I can not praise too highly the Subject Index, which makes it possible for any zoölogist to get in touch quickly with the literature dealing with almost any phase of our knowledge of fishes." Dr. Arthur Willey, professor of zoölogy in McGill University, contributes a thoughtful review to *The Canadian Field-Naturalist* in which, after expressing his general approval of the work, he adds "But mere words can hardly do justice to an arduous undertaking such as this, although its merits are conspicuous."

Not only in English-speaking countries is the Bibliography winning adequate recognition but from other parts of the world as well are coming emphatic expressions of approval. Dr. Ernst Ehrenbaum, leading student in Germany of the migration and distribution of fishes, opens his review in *Die Naturwissenschaften* with the comment "A mighty work lies completed before us, the fruit of most intense labor throughout years, carried on by a group of highly qualified experts with a penetrating grasp of the subject, and resulting in a survey of the literature of a particular field of knowledge that from the standpoints of finality and completeness would be hard to duplicate in any other subject." Jacques Pellegrin, foremost French ichthyologist, closes his review in *Bulletin de la Société Centrale d'Aquiculture et de Pêche* with a special word of recognition for Dr. E. W. Gudger, editor of the Index Volume: "One cannot praise too warmly Mr. E. W. Gudger for having brought to completion such a work, which will greatly facilitate the task of those engaged in research by enabling them quickly to orient themselves regarding the bibliography of all questions concerning ichthyology which they desire to approach." Finally in *O Jornal* of Rio de Janeiro, the leading student of the fishes in South America, Alipio de Miranda Ribeiro, from the fullness of his knowledge concludes that "*The Bibliography of Fishes* is going to be of great service to students of the subject."

THE DANIEL GIRAUD ELLIOT MEDAL.—The warm approval accorded *The Bibliography of Fishes* by the scientific world finds summary expression in the award to Doctor Dean, its originator and editor, of the Daniel Giraud Elliot Medal. This coveted distinction, bestowed each year for a published work of outstanding zoölogic or palæontologic interest, was given to Doctor Dean as of 1921. The prize for 1922 was awarded at the same time to Dr. William Morton Wheeler for a work that, like the *Bibliography of Fishes*, was a Museum undertaking, namely his monumental *Ants of the American Museum Congo Expedition*. Dr. Ferdinand Canu, of Versailles, France, was honored with the medal for 1923. Of the seven awards made since the institution of the prize, three have been bestowed upon scientists connected with the American Museum, the previous recipients being Dr. F. M. Chapman, curator of birds in that institution, Mr. William Beebe, Mr. Robert Ridgeway, and Prof. Othenio Abel.

"DESCRIPTION OF EIGHTEEN NEW SPECIES OF FISHES FROM THE WILKES EXPLORING EXPEDITION PRESERVED IN THE UNITED STATES NATIONAL MUSEUM" by Henry W. Fowler and Barton A. Bean.—We are doubtless warranted in calling this paper a belated report, since the fishes described as new—and to these the authors have confined their attention—were collected more than eighty years ago. So far as localities are given, the species described are, with two exceptions, from South America and Polynesia. Having been taken before the days of deep-sea dredging, they are naturally species belonging to the shore region. The exploring expedition under the command of Wilkes was afloat from 1839 to 1842. While other zoölogical material from this important expedition was reported upon long ago, and in the case of some groups very fully, the collection of fishes seems to have been disregarded by the naturalists of that day. This paper, is, however, only preliminary! A timely letter from Mr. Bean conveys the information that the authors have already prepared a full report for publication. This is of decided interest to students of fishes, especially as accounts of the fishes of Polynesia, where the expedition did its greatest work, are decidedly limited in number. It appears that fishes were collected in all regions visited by Wilkes, including both coasts of South America, many of the islands of Polynesia,

and from New Zealand and Australia westward to Ceylon. The collection is a large one and many of the specimens are still in excellent condition.—CHARLES H. TOWNSEND.

VERTEBRATE PALÆONTOLOGY

CHARLES W. ANDREWS, for many years a distinguished vertebrate palæontologist of the British Museum staff, assistant to Keeper Arthur Smith Woodward, passed away on May 25, at the age of fifty-eight. When last in the British Museum he was engaged in mounting and describing a gigantic skeleton of the straight-tusked elephant (*Elephas antiquus*), which may some time appear as his last published contribution to vertebrate palæontology.

The work which will give him an enduring reputation is his share in the discovery and description of the Upper Eocene and Oligocene fauna of the Fayûm, Egypt, following the original discovery of Hugh Beadnell. With the coöperation of Beadnell, he visited Egypt and made the great collections for the Egyptian and British museums, which formed the basis of his remarkable memoir: *A Descriptive Catalogue of the Tertiary Vertebrata of the Fayûm, Egypt*, published by the British Museum in 1906. This is a monumental work, establishing for the first time in the history of science the original home of the Proboscidea, as well as the probable center of evolution of the Hyracoidea and of the Sirenia. The principal conclusions reached in this great volume will stand as a monument to his keen perception of the affinities and relationships among the vertebrates. The names which he gave to these animals, *Palæomastodon*, *Phiomia*, *Mæitherium*, and *Saghattherium*, were sagaciously chosen.

Vertebrate palæontologists the world over will mourn the untimely loss of this genial and helpful fellow worker, and will extend to his colleagues on the staff of the British Museum and to his family their sincerest sympathy.

PRESIDENT HENRY FAIRFIELD OSBORN of the American Museum has been notified by Dr. Serge d' Oldenburg, permanent secretary of L'Académie des Sciences de Russie that "filled with high regard for his scientific work" the academy has inscribed Professor Osborn's name upon the list of its corresponding members and that the diploma signaling this appointment will be sent to him soon.

THE FAUNTHORPE-VERNAY EXPEDITION

GAPS THAT ARE BEING FILLED IN THE MUSEUM'S COLLECTIONS.—Until very recently the greatest gaps in the bird collection of the American Museum were among the avifauna of tropical Asia and the islands south of that continent. Almost one-third of the genera the Museum lacked were those of birds inhabiting that general region. A very great service is therefore being rendered the institution by the Faunthorpe-Vernay Expedition, which has now collected a total of 847 birds from localities extending from the southern foot of the Himalayas to the southern end of the Indian Peninsula and eastward to Tenasserim and Siam.

The first three shipments were from the northern part of this area, comprising 220 skins prepared by Messrs. Jonas and Kinloch in 1922 and 1923. They represented approximately 128 species, and formed a most welcome and important addition to the collection of Indian birds in the Museum.

Mr. Vernay next sent a dozen specimens (partridges, sand grouse, and a Macqueen's bustard) collected by Major Stockley in Sind and Hissar, and a great Indian bustard from northwest India.

Still more remarkable are the collections recently received from Tenasserim and Siam, where Mr. Vernay is accompanied by the veteran collector for the British Museum, Mr. Willoughby P. Lowe. First came a couple of Burmese peacocks, the male of which is being mounted for exhibition, and two gigantic hornbills, of which one will also fill a gap in the mounted collection.

Two cases recently unpacked contained 596 bird skins, giving a wide representation of the avifauna of the Malayan region, from the smallest flower-peckers to the pheasants and eagles. A great variety of families and genera was included, and it was noted with special pleasure that the shipment contained the falcon-like *Poliohierax*, several beautiful pheasants of the genus *Polyplectron*, some exceedingly large nightjars, not less than fifteen species of woodpeckers, one of the very rare Indian honey guides, and a splendid series of passerine forms. The broad-bills are especially well represented (by five species), as are also the babbling thrushes (Timeliidæ), the bulbuls (Pycnonotidæ), and the thrushes (Turdidæ).



Mr. Arthur S. Vernay seated in front of his grass hut.—At the left is the head of one of the two buffaloes that he succeeded in securing for the American Museum



A Malayan tapir in the Rangoon Zoo.—Among the prizes obtained by Mr. Vernay was a specimen of this species, which he shot by moonlight

Among the mammals obtained by Mr. Vernay unusual interest attaches to a specimen of the Malayan tapir, which was secured in the northernmost part of the range of this species. Sureness of aim such as that required to lay low this animal has few parallels in the annals of marksmanship, for Mr. Vernay shot the tapir by moonlight as it was splashing about in a water hole near his camp.

A cable from Mr. Vernay dated April 24, later confirmed by letter, contained the important announcement that two splendid specimens of the buffalo had been secured,—a bull with horns that, measured from the tip of one horn downward along its wide curve, then across the skull and upward in similar manner to the tip of the other horn, registered 110 inches, and a cow with a horn expansion only one inch less.

Keen interest was aroused by the statement in yet another communication that not only the American Museum, but the New York Zoological Society as well was to be the beneficiary of Mr. Vernay's enterprise and devotion. Two young male gibbons, the one black, the other white, are on their way to New York to join the menagerie in the Bronx. Mr. Vernay writes that they became so tame after a week of kind treatment that when he released them from confinement, they would climb the highest trees only to return at meal times and in the evening, when they would enter the box that was provided for them. "The black one," he adds, "is called Myonk (the Burmese for monkey) and the white one Disha (Deeshah) after one of our elephant men who resembled the ape." Two small crocodiles are also being shipped at the same time.

A summary of the number of different specimens secured by the Faunthorpe-Vernay Expedition discloses the fact that there is a total of 246 mammals, subdivided among the following orders: Insectivora 7, Carnivora 37, Artiodactyla 58; Proboscidea 3, Perissodactyla 5, Rodentia 101, Chiroptera 4, Primates 31.

ASIATIC RHINOCEROSSES SECURED BY THE FAUNTHORPE-VERNAY EXPEDITION.—Under date of May 27 Mr. Arthur S. Vernay cabled President Henry Fairfield Osborn that he had succeeded in obtaining a female and young male of the rare Sumatran rhinoceros (*Dicerorhinus sumatrensis*). Few specimens of this interesting form have reached museums,

though one lived for some years in the London Zoological Gardens. Contrary to what one might expect, *D. sumatrensis* is totally different from the great, one-horned, Indian rhinoceros (*Rhinoceros unicornis*). In the structure of its cheek teeth it shows a closer relationship to the black, or hook-lipped, African form (*Diceros bicornis*). Like the latter it has two horns and in connection with its life in the



A skeleton being conveyed to camp for ultimate shipment to the American Museum

forest has adopted similar browsing habits. It is the smallest of living rhinoceroses, remarkable for its fairly dense hairy coat and the slight development of the folds of its rough granular hide. The Sumatran rhinoceros inhabits the countries east of Bengal, ranging from Assam through certain parts of Burma and Siam into the islands of Sumatra and Borneo. The equally rare, but more widely distributed, lesser one-horned Indian, or Javan, rhinoceros (*Rhinoceros sondaicus*) has extended its haunts into the island of that name.

Not only are the life histories of these three Asiatic rhinoceroses rather imperfectly known but the specimens preserved in museum collec-

tions are inadequate and scientists have consequently been handicapped in their efforts to solve many vexing questions concerning these animals. Such valuable contributions as those made by the Faunthorpe-Vernay Expedition are, therefore, of the highest importance.

For many years Professor Osborn has devoted himself to the study of rhinoceroses and has published extensive works upon the different problems presented by them, especially those of the relationship and evolution of fossil forms. Continued comparison of recent with prehistoric forms is most necessary. Only in this way can one satisfactorily interpret the habits of rhinoceroses of the past, now known only through skeletal remains, often incomplete.

In the evolution of different groups of heavy, gigantic mammals a variety of grotesquely shaped horn structures has been developed, partly to clear a way through the jungle, partly as a means of defense against enemies, and finally as weapons in the competitive battles among the bulls during the rutting period. Guided by these facts Professor Osborn suggested that the great Indian rhinoceros also may use its horn, which sometimes attains a length of as much as twenty-four inches, for purposes of defense.

It is most interesting that his belief is confirmed by a naturalist so well versed in the habits of Indian big game as Colonel Faunthorpe. This sportsman has no doubt that occasionally the Indian rhinoceros uses the horn to inflict wounds upon adversaries such as elephants. He himself shot a rhinoceros in Nepal which had a large deep puncture in the abdomen, as well as other injuries in its hide. These looked as though they were the result of a contest in which horns played the important rôle. They did not resemble wounds inflicted by the triangular, forward- and upward-directed, two lower incisors, generally called the tushes, which are of service also in partly cutting to pieces the tubers and other vegetation on which the animals feed.

For a long time it has been known that the tushes are the chief weapons upon which the great Indian rhinoceros relies in an attack against its enemies including man, as Mr. Roderick T. Mackenzie has kindly pointed out in a letter to Professor Osborn. Mr. Mackenzie states, furthermore, that the horn is always more or less worn away by digging up roots. As the animal rushes forward,

head up, muzzle and lower lip drawn back, and mouth open, the tushes are bared for action. Considering the tremendous impact of the body and the unwonted rapidity of motion of the head under such circumstances, a rhinoceros is liable to inflict terrific wounds. Indeed, it makes a boar's ripping look like the effects of a mild display of temper when it puts into action these sharp, chisel-like weapons. It even cuts open the legs of elephants employed to force it from its retreat.

The mode of attack of the great Indian rhinoceros is, therefore, totally different from that of the two African rhinoceroses, which, deprived of incisors, depend entirely upon charging with head lowered, occasionally goring their enemies with their often sharp-pointed horns. Bulls of the African "black" rhinoceros may fight to the death. Bronsart von Schellendorf gives us the following account of such a contest: "In the next moment both bulls rushed around each other in a circle, furiously snorting, and each one trying to plunge its horns into the body of the other. The older of them suddenly stumbled. Immediately he received two deep thrusts in the breast and belly. The long, sharp, dagger-like horn of his adversary had entered him for about two-thirds of its length. In vain did he try to raise himself. Quick as a flash he received another well aimed thrust in the middle of the neck. After several piercing shrieks he lifted his heavy head up and down, trembled and died."—H. L.

PUBLIC EDUCATION

THE EXPEDITION OF THE AMERICAN MUSEUM TO SWEDEN AND LAPLAND has begun its work under conditions that are an assurance of success. Thanks to the friendly assistance of Legationsrådet Hendriksson, a letter was secured from the head of the educational department (Eklestistik Departementet) of Sweden, requesting all those connected with the schools, colleges, and universities to give Dr. G. Clyde Fisher every assistance within their power. Doctor Fisher is, furthermore, being aided in his visits to the schools by Miss Staël von Holstein, who in addition to her knowledge of the Swedish language and of Swedish educational institutions has a viewpoint regarding American educational standards gained through several years spent at Columbia University. One of Doctor Fisher's main purposes in visiting Sweden is to obtain an insight into the Swedish educational

system, regarding which he will lecture before the Museum on his return, and there can be no doubt that, as a result of the privileges extended to him, he will accomplish more even than he had ventured to hope.

Many attentions have been shown Doctor Fisher and his associate in the expedition, Mr. Carveth Wells, by eminent individuals. They have been entertained, among others, by Baron De Geer, the distinguished geologist, and Baroness De Geer, and also by Mr. Cord Meyer, secretary of the American Legation, who invited for the occasion Dr. Robert Andrews Millikan, upon whom was recently bestowed the Nobel prize in physics, and Mrs. Millikan. A dinner was tendered the representatives of the American Museum by the Swedish-American Foundation, of which Professor Arrhenius is president, and at the banquet Doctor Fisher had the honor of being seated beside Mrs. Arrhenius. The public press, reflecting the popular interest, has devoted many a column, with portrait insertions, to the expedition.

THE TEACHER AND THE MUSEUM.—In conformity with its established custom, the department of public education, American Museum, tendered a reception to the faculty and the graduating class of the New York Training School for Teachers on June 19 and to the corresponding groups of the Maxwell Training School for Teachers on June 20. It is of prime importance that prospective educators should know of the various ways in which the Museum is prepared to assist them, and at these gatherings the graduating classes have the opportunity, not only of establishing contact with those within the Museum who are engaged in educational work, but also of seeing through the illustrated addresses that are a feature of the day's entertainment the facilities in the way of slides and similar lecture materials that are at their disposal. Members of the Museum staff guide the visitors through the exhibition halls and the department of education, and the activities terminate with the serving of tea.

MAMMALS

MR. G. H. H. TATE, field collector of the department of mammals, American Museum, has returned to the United States for a brief sojourn after an absence of fourteen months in Ecuador. The progress of his work, both independently and in collaboration with Mr. H. E. Anthony during the latter's recent visit

to the west coast of South America, has been referred to from time to time in *NATURAL HISTORY*, and readers of the magazine are, therefore, conversant with his record up to November, 1923. Since that time he has taken three field trips: (1) from Ambato to Guayaquil, for the purpose of making a cross-section of the region to the north of Mt. Chimborazo, (2) to the Island of Puna, off the coast of Ecuador, (3) to the Oriente side of the Andes.

It is the last-mentioned trip that deserves especial emphasis, for it consumed a period of three months and yielded valuable specimens and interesting observations. Mr. Tate established eight camps in all, lingering at each for a sufficient number of days to study the faunal conditions. The first two camps were in the high temperate forest, the second being pitched at the base of the volcano Tungurahua, which erupted violently some years ago and sprinkled ashes even during Mr. Tate's sojourn.

From this altitude he worked down the Pastaza River, past the falls of Agoyán, which, 30 feet in width, tumble from a height of about 150 feet, on to the third camp at Mirador at an elevation of approximately 5000 feet. This spot is the subtropical type locality worked by the old collectors Simons and Palmer. The fourth camp, established at La Palmera, was maintained for two weeks and yielded important collections.

Thence Mr. Tate moved down to Mera, the center of the wet belt, where there is rain nearly every day of the year and the traveler wades about in mud that is perennial. Several interesting forms were discovered in this locality. Due to the forbidding character of the country mules could not be depended upon beyond this point and it became necessary to send to the Indian settlement at Canelos for bearers.

The first day's travel beyond Mera brought the party to Puyo, a place somewhat disliked by the Indians on account of the prevalence there of vampire bats that make their insidious attacks at night. On the second day a stop was made at Indillama, a station erected by the Ecuadorean government for the convenience of travelers. On the third day the party reached Canelos.

Canelos is an Indian settlement with a population of 300. Large well-thatched houses are scattered about in the forest, and each accommodates several families. The

floors are earthen and the principal articles of furniture are beds and cots of bamboo. Each house contains at least a half dozen *bodoqueras* (blow guns), on which the Indians rely for their meat supply. The work of preparing the soil and the planting of *yuca* and *platano* is left to the women.

Mr. Tate collected for ten days at Canelos and then, through the kind arrangement of the resident Dominican priest, was conveyed by canoe to Sarayacu, a similar settlement three days' travel down the Rio Bobonaza. From this point a journey was made overland to Rio Copataza, another type locality, where Mr. Tate had the assistance of six Indian collectors.

The rainy season was now drawing to a close and accordingly a return was made to Mera. After eleven days of continuous travel Mr. Tate reached this spot and, securing riding animals, made his way over the Andes back to the coast. During the three and a half months consumed in this trip to the Oriente, Mr. Tate collected about 550 mammals, not to mention reptiles, batrachians, and plants.

"THE ALLEN MEMORIAL VOLUME."—In recognition of the important services of Dr. J. A. Allen during the thirty-six years of his curatorship in the American Museum, President Henry Fairfield Osborn and the Trustees have decided to devote one of the volumes of the *Bulletin*, under the designation of "The Allen Memorial Volume," to the publication of the posthumous papers of the distinguished mammalogist. Two of the four articles proposed for inclusion—that on the insectivores and the one on the squirrels collected by the American Museum Congo Expedition—made their appearance two years ago. To these has now been added the third report, dealing with the large collection of Congo carnivores, and only one more report, therefore,—that concerned with the primate collection from the same region,—is necessary to round out the volume. This fourth report is nearing completion.

The carnivores were one of the last groups among the Congo material to which Doctor Allen gave his attention. After the author's death the manuscript was arranged for publication by Mr. Herbert Lang, associate curator of African mammals, who had had the privilege of assisting Doctor Allen in the working up of the report.

Among the 588 specimens of Carnivora represented in this West African collection Doctor Allen recognized two genera and eight forms as new to science. In view of his conservative attitude in the matter of new descriptions, the proportion is large. Though he considered that some of the specimens, temporarily referred to forms already known, were worthy of subspecific distinction, he did not feel justified in thus designating them at the time, due to a lack of adequate comparative study material. Throughout the report stress is laid on the great need for a satisfactory basis of differentiation. In extensive series of a single form collected in one locality or district, it is remarkable how great can be the range of individual variation.

One of the noteworthy discoveries figuring in the report on the carnivores is that of a fish-eating genet, *Osbornictis*, illustrated by an excellent color plate showing the uniform dark-brown tone of its pelage. This genet is one of the many examples of adaptation peculiar to African mammals. The new genus which it represents Doctor Allen named in honor of Professor Osborn, who made it possible for him to devote his entire time during the last years of his life to the working up of the Congo material. As a result of this generous provision Doctor Allen was able to complete his study of so large a proportion of the mammals collected by the Congo Expedition.

The other new form requiring generic distinction, *Xenogale*, falls within the herpestine group. In external appearance it so closely resembles *Atilax* as to have been mistaken for it in the field, but in cranial characters and dentition the two forms present little similarity.

A feature of this report is the extensive series of comparative drawings of the skulls of the various genera represented. Complementing these drawings are the many photographic illustrations, for the most part taken in the course of the expedition. They enhance the value of the report, especially for those who desire to make use of it as a guide for future study in the field.—H. L.

EAST AFRICAN TROPHIES GIVEN BY MR. E. MALLINCKRODT, JR.—The American Museum recently secured through Mr. Edward Mallinckrodt, Jr., the first specimens from the eastern limits of Lake Victoria Nyanza, near the Mara River, that have found place in its

collections. Among the objects presented are the skull and scalp of an especially fine bull eland (*Taurotragus oryx pattersonianus*)—the largest of antelopes and a member of the tragelaphine group,—a fine long-haired pelt of a spotted hyæna (*Crocota crocota germinans*, and—even more desirable—an exceptionally large skull of the hook-lipped, or "black," rhinoceros (*Diceros bicornis*) from the neighborhood of Lolgorien.

HISTORY OF THE EARTH

LA SOCIÉTÉ GÉOLOGIQUE DE BELGIQUE invited the American Museum to participate in the semi-centennial celebration of the founding of the society, held at Liège, July 27-30. President Henry Fairfield Osborn requested His Excellency J. Malfeyt, a life member of the Museum, to represent the institution on this important occasion, General Malfeyt having evinced his interest in the Museum through the great assistance he rendered some years ago to its Congo Expedition. The geology of the Congo and of the regions bordering upon it was one of the principal topics presented during the gathering, another being a survey of the activities of the society during the fifty years of its existence. Excursions to points of interest and a banquet were other features of the celebration.

CONSERVATION

A NATIONAL CONFERENCE ON OUTDOOR RECREATION, called by President Coolidge, was held in Washington, May 22-24, and as an outgrowth of its deliberations there has come into being a permanent organization, made up of associations that are interested in wild life and out-door activities and that through such a super-organization can best correlate their efforts. A meeting is planned annually at which the constituent associations will pass upon the common policy, each association irrespective of the number of its delegates present having but a single vote.

That the organization has started with every prospect of continued success is indicated by the standing of the men who attended the conference and the earnest spirit and desire for harmonious coöperation that characterized the gathering. President Coolidge delivered the address of welcome and the honorary chairmen of the successive sessions were the Hon. John Wingate Weeks, Secretary of War, the Hon. Henry C. Wallace, Secretary of Agriculture, the Hon. Hubert

Work, Secretary of the Interior, the Hon. Herbert Hoover, Secretary of Commerce, and the Hon. James J. Davis, Secretary of Labor. The executive chairman of all the sessions was the Hon. Theodore Roosevelt, whose vigorous and stimulating qualities as presiding officer were reminiscent of the leadership exercised by his father before him. Official delegates representing more than one hundred associations interested in wild life, in the park and playground movement, in child welfare work, and related activities, were present and listened to addresses on different phases of the common problem that designated speakers had been invited to contribute. Dr. Frank M. Chapman, of the American Museum, delivered an address on "Birds and Man" in the session devoted to the "Wild Life Resources of the United States."

FOUR HUNDRED YEARS OF GROWTH DESTROYED.—In constructing a road to the North Grove of Calaveras "big trees," the highway engineer found confronting him a magnificent specimen of a sugar pine,—a species that Muir has designated "the noblest pine yet discovered." In height it grew to 240 feet, in circumference it measured more than 25. With an estimated age of 400 years, it must have begun life about the time when Balboa first gazed upon the Pacific; but the centuries had not robbed it of its storm-defying strength. The unimpressible engineer was not deterred by consideration for its beauty or its age. The tree had no message for him. Not even the thought that the road he was commissioned to construct was to serve as a highway to the lofty splendor of one of the world's most magnificent groves of trees could win respectful treatment for the age-old sentry that stood just outside of the precincts. A slight curvature to the right or left, and the tree would have been spared. But no, the road must follow its undeviating course, and the merciless swings of the ax in short time laid low a firmly rooted giant that the tempests of the past had failed to budge.

One is glad to note that indignation over this thoughtless act of sacrifice has been widespread. The *Stockton Record* has voiced its protest in a vigorous editorial and the *St. Paul Daily News* writes trenchantly of the incident under the heading "He Sawed Down 400 Years' Work." Even if a new sugar pine were planted on the spot where the old tree stood and succeeded in withstanding all

of the vicissitudes of the centuries, generation upon generation of men would grow from childhood to manhood and wither away in old age before the new tree could reach the venerable stage represented by its predecessor. But if we cannot conjure back what is destroyed, an awakened public conscience can at least take measures to render less likely a repetition of such inflexible destruction.

In contrast with this incident may be cited one for which The Shevlin-Hixon Company of Minneapolis deserves honorable mention. Along the highway leading into Bend, Oregon, was a growth of timber controlled by this lumber company. The company would have been within its private rights if it had chopped down this stand to the last tree, but this corporation had a *soul* that responded to the appeal of beauty, and in the public interest set aside a strip of very handsome timber. In addition, it gave as a memorial to the late Thomas Shevlin a whole grove of trees in the Tumalo Cañon in Oregon, and thereby aided the Save the Redwoods League in its struggle to preserve the scenic beauty of our Northwest. Another recent gift which the League deeply appreciates is that of the Pacific Lumber Company, which on February 4 deeded to the State of California a magnificent tract of 289 acres of Redwood timber located in the heart of the State Redwood Park and known as South Dyerville Flat. The grove is a memorial to Simon J. Murphy, founder of the Pacific Lumber Company. Through this gift and the purchase of an adjoining grove known as North Dyerville Flat, there has been completed a stretch of twelve miles of highway lined by giant trees and set aside for all time for the enjoyment of visitors to the region. Finally, through the generosity of a donor who modestly withholds his name the League has been able to acquire 113 acres on which are some of the largest and most perfect trees of the entire region.

Important as these donations have been, the League wants to extend its activities and looks forward to the day when a National Redwoods Park, containing at least 20,000 acres, may be an accomplished fact.

ARCHÆOLOGY

"OUR FORERUNNERS."—Of all the various branches of scientific research there is none that excites more general interest than that concerned with the origin and development of

prehistoric man. The recent attacks upon the doctrine of evolution—especially as it affects man's ancestry—have greatly augmented this interest and increased the demand for trustworthy and understandable accounts of the life and times of those peoples who lived before the dawn of history.

A notable contribution to such literature is *Our Forerunners*¹ by Dr. Miles C. Burkitt, presented by its author to Prof. Henry Fairfield Osborn and recently placed in the Osborn Library of the American Museum. This brief account of the civilizations of Palæolithic man in western Europe and along the shores of the Mediterranean gives, as it were, a bird's-eye view of man's prehistory. Within the covers of a small and inexpensive book that will easily slip into the average pocket, the author has contrived to outline the history of discovery, the geologic conditions, the climate and fauna, the technique of working flint, the principal types of tools, the main and minor cultural divisions, the fossil human remains, and the art of Palæolithic times. And with all this, he is yet able to devote a chapter to the motives for Palæolithic art, as they may be conjectured from the practices and beliefs of existing primitive tribes, and to present vividly picturesque descriptions of the course of daily life during the Stone Age.

In order to achieve such condensation only main outlines of the principal features of prehistory could be given, and much that is of great interest has necessarily been omitted. It is, perhaps, a little surprising that the paragraphs on "Mousterian or Neanderthal Man" fail to mention the skull of Gibraltar found in 1848, as this is not only the earliest known discovery of Neanderthaloid human remains, but also the best preserved female skull of that type. On the whole, this little book gives a careful, conservative presentation of our present knowledge of Palæolithic man, and in its simple, non-technical language is admirably calculated to make the results of recent research available to readers unfamiliar with scientific terms but none the less keenly interested in all that concerns *Our Forerunners*.

THE MARSH DARIEN EXPEDITION

Under date of March 24, Mr. C. M. Breder, the representative of the American Museum on the Marsh Darien Expedition, wrote from Yavisa, Panama: "As soon as the boat comes to take our stuff and this letter,

¹Burkitt, M. C. *Our Forerunners*. Williams & Norgate, London. 1923.

we shall leave for parts unknown." The Cuna country, the objective of the expedition, has had an evil reputation. It has been said that parties that entered it in the past have not returned from its fastnesses and the belief prevailed that they had been killed by hostile Indians. It was the possible danger from this source that was uppermost in the minds of those who followed with interest, mingled with concern, the progress of the expedition.

Serious obstacles on the part of the natives were not encountered; but the evil reputation of the Cuna country is nevertheless justified on other grounds. A more sinister foe than savage man has claimed its victims among those who dared to cross the boundaries of this forbidden territory. The first to succumb was a representative of the Panamanian government assigned to the expedition, whose death may possibly be ascribed to disease contracted before the journey was undertaken. Overstrain, infection through the bite of an insect, and the tropical climate completely undermined the health of Mr. John L. Baer, the ethnologist of the expedition. For a time the hope was entertained that it might be possible to carry him, fever-racked as he was, out of the interior to Caledonia Bay on the Atlantic Ocean and thence take him by ship to some port where he might receive medical attention. But this hope proved vain. Mr. Baer died a martyr to science in a region the mysteries of which he had set out to penetrate.

Mr. Breder himself did not escape unscathed. He developed a case of typhoid and malaria, which necessitated his return to Colon. For a time grave anxiety was felt by his family and friends, but in answer to their hopes for his recovery, he is today restored to health and strength.

While the results attained by the expedition cannot be weighed in the balance with the sacrifice of life that it has entailed, it is, nevertheless, some consolation to know that the brave men who faced disease and death in their devotion to science have helped to attain the objects for which the expedition set out.

The chief purpose was to locate the blond Indians which, it was known, lived somewhere in the area selected for penetration, and to inquire into their origin and mode of life. Complete success attended this search as indicated in the following cable received by the department of anthropology, American Museum, under date of June 18:

"Marsh arrived Colon with three white Indians, golden hair, hazel blue eyes, white tender skins: two boys with liver spots, girl comparatively clear; gums pink, skulls unusual in size and shape, large, round, decidedly different from typical San Blas.

Breder."

Early in July these Indians were brought to New York and anthropologists from leading institutions were invited to meet them and give collective consideration to the problem presented by their physical peculiarities. The public interest in these abnormal representatives of the "red" man was indicated by the number of newspaper articles devoted to the *white* Indians.

Though other phases of the work of the expedition yield in spectacular appeal to this anthropologic investigation, much of scientific interest was discovered also in the field of zoölogy. Brief mention may be made of some of the results achieved by Mr. Breder during the week spent at Yavisa prior to the penetration of the interior. Here he had a rare opportunity to make an intensive study of a small section. When he first arrived, all the frog streams save one were dry, waterless beds, and the outlook was discouraging. But two solid days of rain transformed the scene, and before his departure he was able to obtain life-history data regarding seven species of frogs, as well as photographs and specimens. Of four of the species he managed to secure a developmental series. After leaving Yavisa he gathered data regarding several other species.

Mr. Breder's collecting is not confined to amphibians. He has been taking also reptiles and fishes, and incidentally birds. Preliminary examination of the material he has brought together indicates that there are included at least several new species of fishes and reptiles.

AMPHIBIANS AND REPTILES

A SPHENODON GROUP FOR THE AMERICAN MUSEUM.—After more than ten years of correspondence and efforts on the part of a number of scientists, the American Museum is at last to have a group illustrating the home life of the *Sphenodon*—that "living fossil" which has the appearance somewhat of a lizard but is actually more closely allied to the crocodiles. The final arrangements for securing this material were made by Doctor Hovey during his recent trip to New Zealand.

Sphenodon is the only living representative of that order of reptiles known as the Rhyncho-

cephalia, a group which apparently reached its ascendancy during Mesozoic times. *Sphenodon* is found today only on some of the small islands off the coast of New Zealand, where it frequents the burrows of a petrel (*Puffinus carneipes*). This association of reptile and bird has probably, to a large extent, permitted the survival of *Sphenodon* to recent years, for the reptile not only secures the protection of the petrel's home but feeds to a large extent upon the food that the parent birds bring to their young. Although some writers have claimed that these odd companions get along in perfect harmony, other investigators report that the petrels frequently try to drive the reptiles out of their homes. The group of *Sphenodon* in the American Museum will represent just such a home scene, for, thanks to the kindness of Doctor Speight and Mr. Sladden of New Zealand, the American Museum now has specimens of the petrel and its eggs as well as *Sphenodon* and its eggs, and all accessories necessary for such a group. In addition to illustrating a curious case of parasitism, the *Sphenodon* Group will have interest because of the extreme scarcity of the specimens.

Today *Sphenodon* is rigorously protected by the New Zealand Government; it is, nevertheless, almost extinct, for a large hawk (*Circus gouldi*) has become naturalized on the island and feeds to a large extent upon this reptile. Formerly the natives of New Zealand considered *Sphenodon* a great table delicacy, and as the reptiles are easy to catch, these people made great inroads upon them. It is highly doubtful whether *Sphenodon* will survive in spite of the present strict protection enforced by the government.

AMPHIBIANS OF THE CONGO.—Dr. G. K. Noble, curator of the department of amphibians and reptiles, American Museum, has recently issued his report on the Amphibia collected by the American Museum Congo Expedition. The report constitutes Part III of *Contributions to the Herpetology of the Belgian Congo*, the two preceding parts, devoted respectively to "Turtles, Crocodiles, Lizards, and Chameleons" and to "Snakes," having been prepared by Mr. Karl Patterson Schmidt.

Doctor Noble's report treats of 2170 specimens, distributed among fifteen genera and fifty-three species. Of the three species described for the first time, one (*Hymenochirus curtipes*) comes from the open country near the mouth of the Congo, and differs

conspicuously from Cameroon specimens of *H. battgeri*, which have much greater length, enlarged lateral tubercles, broad heads, and indented webbing of the digits. The other two are known only from the forests of the Ituri district, many miles farther inland. One of them, *Hyperolius langi*, named after Herbert Lang, leader of the expedition, is reddish brown above with an indistinct stripe of pale yellow about the eye and the shoulder. The other, *Rana Chapini*, named in honor of Mr. James P. Chapin, Mr. Lang's associate in the expedition, proves to be larger than any related form.

While no comprehensive work on African Amphibia has appeared since Boulenger's catalogue was issued in 1882, papers on the subject have been appearing with considerable frequency during the four decades separating that date from the present and the bibliography incorporated in the report will, therefore, be a welcome aid to many. Another outstanding feature of the report is a check list of the Amphibia of Africa. The accepted opinion as to the status of the various species is indicated and the ranges are given in so far as it is possible. Finally, mention should be made of the series of batrachian portraits taken in the field by Mr. Lang, which constitutes a striking pictorial contribution to the report.

The reports dealing with the American Museum Congo Expedition, several of which are still in course of preparation, will require, it is estimated, twelve *Bulletin* volumes for their presentation. It is the plan to adopt for the completed work a series title: *The Zoology of the Belgian Congo*.

MARINE LIFE

DIVING FOR CORALS AT ANDROS ISLAND.—Dr. Roy W. Miner, curator of lower invertebrates, American Museum, writes from Andros Island in the Bahamas, that on a beautiful calm moonlight night the expedition of which he is in charge crossed the sixty-five miles that separate Andros from Nassau, arriving off the reefs south of Mangrove Cay at daybreak on June 17. The purpose of the expedition is to obtain material for the coral group that is to be a feature of the projected hall of ocean life, American Museum. The equipment required, including the Williamson tube, is of an elaborate character, as may be inferred from Doctor Miner's description of the strange assortment of craft that

were towed in Indian file to the scene of operations:

"En route our fleet consisted of the 'Lady Cordeaux,' which is the government tug, and without which it would have been impossible for us to have negotiated 'The Tongue of the Ocean'; second, the submarine tube barge, 'Jules Verne,' with its odd-looking tower and ventilator; third, the pontoons bearing the chain hoist, an extremely important unit in the fleet; fourth, the 'Bitter End,' a heavily built lifeboat containing a motor; fifth, the 'Standard,' our floating headquarters, Captain Joe Bethel's fine 45-foot gasoline launch, with sleeping quarters for seven people including the captain; sixth, the 'Nautilus,' a small but powerful gasoline tender for the barge; and finally, two dinghies."

Such a fleet would occasion remark even in New York harbor; imagine, then, the furor its arrival must have created in a little settlement where nothing usually occurs to break the monotony except the biweekly mail schooner, an occasional hurricane, and the periodic deaths among the oldest inhabitants!

On June 19 the members of the expedition saw the outer side of the Andros reef from the tube for the first time and its beauty thrilled Doctor Miner, who thus describes it:

"The main reef is composed of a dense forest of *Acropora palmata*, for all the world like an orchard of apple trees but much more closely set with interlacing branches rising from the reef platform from twelve to sixteen feet and breaking the water surface at low tide,—a jungle of marble trees fading into the opalescent blue of the watery fog. Clearings in this stony woodland are dotted with clusters and clumps of postlike growths of *Orbicellidae* combined with symmetrical fronds of deer-horn corals and gorgonians. Large tracts of the reef floor in front of the forest are completely covered with grotesquely branching elkhorns, their weird spikes contorted and interlaced like a defensive barrier. Troops of brilliantly colored fishes filed past in solemn processions, and a great trumpet fish glided past in solitary state.

"Into the midst of this strange world Williamson floated down in his diving helmet and advanced with peculiar half-gliding strides among the coral clumps. An immense crowbar was lowered to him on a rope. Poising this as an armored knight might place his lance in rest, he attacked the base of a coral

clump and it fell at his touch. He then attached the cluster to a rope lowered by the men above, and the corals became a part of our collection.

"We have also used the 10-ton chain hoist most effectively. In fact, it is only by means of this apparatus that we can get up the heavier and larger pieces. It permits a direct pull and the corals are drawn up between the two parallel pontoons. These have a very shallow draft and the corals are easily floated to the beach irrespective of their weight. There Mr. Mueller takes them in charge and starts the bleaching process, while the sea fans and gorgonians are hung up on lines to dry.

"We have to take our chances on the outer reef as the wind often rises and prevents operations there until calm weather again prevails. At other times we work inside the reefs and in the more protected channels. Williamson has spent hours under the water in his diving helmet and has been indefatigable in the securing of specimens. The Museum owes a great deal to his coöperation and unquenchable energy."

BIRDS

At the annual meeting of the National Education Association held in Washington, D.C., Dr. Robert Cushman Murphy, assistant director, American Museum, addressed an audience composed of eight hundred teachers of geography, gathered from all of the states of the Union, on the achievements and prospective work of the Whitney South Sea Expedition under Mr. Rollo Beck,—an expedition which has been making a painstaking study of the bird life of Polynesia and in the course of its cruises has contributed incidentally to making more widely known the interest of the island-dotted ocean that lies beyond the reach of the generality of travelers. The lecture was one of two which the National Geographic Society arranged in honor of the gathering.

NEW MEMBERS

SINCE the last issue of *NATURAL HISTORY* the following persons have been elected members of the American Museum, making the total membership 7693:

Life Members: MRS. W. R. GRACE; MESSRS. WILLIAM SHEPHERD DANA, DESMON FITZGERALD, FRANCIS L. HIGGINSON, DAVID G. JOYCE, AND JOSEPH F. STIER.

Sustaining Member: MISS SUSAN M. STURGES.

Annual Members: MESDAMES MAX FARRAND, HORACE WESTLAKE FRINK, JOSEPH J. KLEIN, CHARLES HOWLAND RUSSELL, HARRY J. SMITH, K. B. SPENCER, E. S. STEINAM, EDMUND A. STIRN, ARTHUR L. STRASSER, EDWARD E. THALMANN, JOSEPHINE A. THIBAUT, ALDEN H. WEED; THE MISSES KATHERINE BIGLEY, MARGARET S. REMSEN, HELEN R. SLOAN, MARGARET E. TURNER; DOCTORS SAMUEL J. KOPETZKY, PHILIP W. NATHAN, CHARLES NORRIS, GEORGE T. STRODL, A. McI. STRONG, WALTER TIMME; MESSRS. BORIS A. BOKHMETEFF, ALFRED T. BEALS, WILLIAM F. BISHOP, H. BLAIR-SMITH, F. RHINELANDER BROWN, STEPAN DE KOSENKO, ISIDOR GREENWALD, ANGELO HIRSCH, JACOB D. JAIS, FRED'K LOWENHEIM, JOHN C. LYETH, STOCKTON MULFORD, ELIE NADELMAN, ARTHUR K. OHMES, J. E. RIDDER, ALBERT R. ROGERS, DEDERICK H. SCHMIDT, CHARLES GREEN SMITH, JAMES A. SMITH, CHAS. P. SODEN, H. BOARDMAN SPALDING, M. SPARK, FRED F. STEINHARDT, SAMUEL C. STEINHARDT, WILLIAM H. STEINKAMP, HAROLD W. STEVENS, LOUIS STIEGLITZ, CHARLES G. STRATER, M. B. STREETER, WALTER E. STROBEL, MALCOLM SUMNER, EDWIN S. S. SUNDERLAND, WOODBURN SWORMSTEDT, EMILE TAS, ARTHUR W. TEELE, JAMES P. THOMAS, BRAINARD TOLLES, PAUL R. TOWNE, JAMES H. TURNER, LANGDON B. VALENTINE, E. R. VAN SICKLE, A. WHITRIDGE, and ALBERT WORTMAN.

Associate Members: MESDAMES W. H. COOLIDGE, JR., ARTHUR S. ELDRIDGE, THOMAS J. EMERY, S. B. GRINNELL, ARTHUR P. NAZRO, GEORGE P. SANGER, E. C. STREETER, JOHN L. THORNDIKE, GEORGE UPTON, I. DE VER WABNER, J. BERTRAM WILLIAMS; THE MISSES KATRINE ROSALIND GREENE, L.

E. REGGIO, LUCRETIA S. WATSON; PROF. E. B. BABCOCK, JUDGE MARCUS MORTON; COL. A. D. AKIN; REV. C. K. BENEDICT; DOCTORS RANDOLPH K. BYERS, ELMER T. LEARNED, S. J. MIXTER, FRANCIS W. PALFREY, WILLIAM L. RICHARDSON, STEPHEN RUSHMORE, WILFRED SEFTON, HAROLD C. STUART, HOWARD T. SWAIN, JAMES C. WHITE, FRANCIS H. WILLIAMS; MESSRS. E. W. ALLEN, ALBERT F. BIGELOW, NATHAN D. BILL, ALLISON BISHOPRIC, L. F. BRIGHAM, D. R. BULLEN, JOSEPH C. DEGIORGIO, J. DE WITT, ROBERT E. DEXTER, THEODORE S. DOHRMANN, WALTER A. DRAPER, W. S. WESTERMAN, EDGAR, A. O. ELZNER, GRENVILLE G. GARCEAU, HARING WHITE GRIGGS, JOHN L. HALL, LESLIE HASTINGS, JOHN HEARD, JR., FRANKLIN W. HOBBS, A. R. HERR, JOHN K. HOWARD, E. W. HOWE, ROBERT W. HUNTINGTON, RALPH B. IVES, ARTHUR M. JONES, ROBT. RALSTON JONES, ROGER S. KELLEN, CARL T. KELLER, B. M. KINSEY, HUGO KLAUBER, JOHN A. KNOWLES, MORRIS F. LACROIX, JOSEPH P. LIVERMORE, HENRY LOY, GEORGE ARMSTRONG LYON, ALBERT MATTHEWS, WALTER J. MITCHELL, CABOT J. MORSE, J. M. MORTON, JR., B. P. P. MOSELEY, FRANCIS S. MOULTON, GEORGE S. MUMFORD, JOHN B. PAINE, RICHARD C. PAINE, FREDERIC PARKER, CYRUS E. PHILLIPS, PHILIP L. REED, F. L. W. RICHARDSON, JR., ALFRED L. RIPLEY, WM. PRESCOTT ROGERS, RICHARD SEARS, ED SEWALL, CLARENCE R. SHOEMAKER, CHARLES WILKINS SHORT, CLAUDE DE WITT SIMPSON, R. PAUL SNELLING, NATHAN B. TALBOT, CHAS. H. TAYLOR, GEO. R. TENNENT, BENJAMIN W. THORON, GEORGE H. TIMMINS, JOSEPH R. WALKER, BENTLEY W. WARREN, FISKE WARREN, SAMUEL D. WARREN, FREDERICK S. WHITWELL, and WINTHROP C. WINSLOW.

